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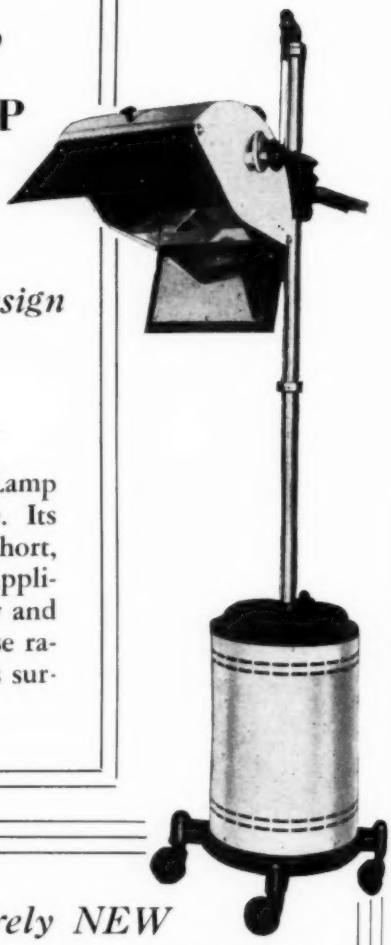

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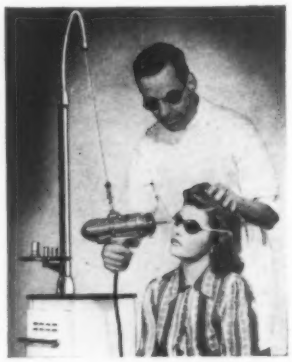

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CULTIVATED RELAXATION IN "ESSENTIAL" HYPERTENSION *

EDMUND JACOBSON, Ph.D., M.D.

CHICAGO

The production of sustained high blood pressure through compression of the renal artery by Goldblatt and his associates has focussed attention on the ischemic kidney as the hypothetical source of a pressor principle whose action might explain not only what has been called renal hypertension but "essential" hypertension as well.[1] While experimental and postoperative evidence is being gathered, it seems timely to emphasize that *renal* arteriolosclerosis, the distinguishing pathologic mark in most instances of human "essential" hypertension at autopsy, has *not* been reproduced in the Goldblatt animals. Furthermore, even if the existence of a pressor principle in the blood should be demonstrated (by methods more delicate than those which we now possess), and even if the results from operation should develop a more convincing character than they have up to the present time as for instance protracted lowering of blood pressure by surgery,[2] it seems justified to continue our search for factors to explain and to treat arterial hypertension. The search is not ended by reclassifying "essential" hypertensive cases into types, according to the pathologic process suspected or identified; for we still face the problem how to explain heightened pressure in each type.[3]

Under any hypothesis, whether a pathologic process is present or absent, we shall be obliged to reckon with the common observation that blood pressure generally increases during moments of emotion or of nervous excitement and then subsides. Such increases, often loosely said to be due to "psychic" elements, are more accurately attributed to generalized increase of skeletal and visceral muscular tension, definitely measurable in action-potentials (plus the brain and cord and chemical processes inevitably involved). It can be assumed that rises of blood pressure "due to emotion" fall into the same category; for emotional states are specifically characterized by increased skeletal and visceral muscular tension. Physiologic factors are therefore in evidence to explain the origin of the rise in pressure under so-called psychologic influences. Where action-potentials from skeletal and other muscles characteristically exceed the normal, the term neuromuscular hypertension has seemed appropriate. That neuromuscular hypertension exists as a basic pathophysiologic condition and is widespread among the population has been amply set forth and may be here assumed.[4] Physiologic considerations suggest that it is among the class of neuromuscular hypertensives that "essential" hypertension is distributed. Evidence for this view can be discerned in the results of "cold-pressor" tests, where not every excitable individual but only certain ones give markedly positive reactions, suggesting that they are or may become victims of "essential" hypertension. Such evidence also is a matter of common experience of clinicians who find that not all their highly nervous patients (including those afflicted with hyperemotional states, fears, phobias, anxieties, habit spasms, stuttering, stammering, compulsions and obsessions) but only a much more limited number reveal a chronic elevation of blood pressure.

Certain individuals of a non-neurotic type, as clinicians can readily confirm, doubtless are included among the "essential" hypertensives. Some of

* From the Laboratory for Clinical Physiology, Chicago.

these patients have a "matter-of-fact" bearing and appear more or less calm and determined. However, in the present studies it has often been found that they resemble the nervous types in that they fail to relax. In some of these instances at least, their skeletal musculature exhibits superfluous contraction, relatively steady or intermittent, in patterns variable and changing in time and locality. Since the contraction of skeletal musculature is commonly voluntary, it is not surprising that a study of these persistent contractions with the aid of trained subjects has led to the conclusion that they constitute efforts on the part of the hypertensive individual to meet environmental conditions and people as well as to make his own internal adjustments. His muscles are found to be inordinately tense at times, in that he is making efforts intermittently or persistently, including moments when he should be relaxed instead. The influence of such contractions according to laboratory studies, is to prevent the blood pressure from subsiding to the lower or basal levels characteristic in the relaxed state.[5]

If blood pressure levels tend to increase in the presence of neuromuscular hypertension, the "essential" hypertensive patient should be examined systematically for signs of this condition. For whether the renal arteriolosclerosis so commonly found at necropsy is a "primary lesion" or is a consequence of prolonged vascular hypertension, the evidence suggests that "essential" hypertension results not only from a constitutional predisposition but also from efforts made each day in the biologic struggle. The pathologic factor which we presume to exist may from the present point of view be called the "essential cause," while the neuromuscular tensions act as the "exciting cause." Accordingly the concept of neuromuscular hypertension in daily living, including reflex as well as voluntary muscular efforts, provides us, in strictly physiologic terms, with a link between the so-called "psychic" influences and their effects on arterial structure—a link likewise between efforts in daily living and what some pathologists call "wear and tear," to which they in part attribute the pathogenesis of arteriosclerotic and other advanced conditions.

A common finding in neuromuscular hypertension is the tendency toward excessive or persistent "thinking"—whether about self or business or social affairs or other matters. From a physiologic standpoint, we can no longer look upon "thinking" or mental operations in general, whether devoid of emotion or not, as processes which take place in closed circuits exclusively within the brain. All the evidence has pointed to the conclusion that mental operations include a neuromuscular component quite as essential as the cerebral component.[6] If these facts are pertinent, we can no longer ignore the known physiology in this field in its application to "essential" hypertension.

Experimental evidence that excessive neuromuscular tension (plus the necessarily involved reflex nervous and chemical processes) tends to maintain an elevated blood pressure even in normal individuals has been presented in three preceding articles. Reduction in both systolic and diastolic pressure was commonly effected if there occurred a demonstrable change in the skeletal musculature action-potentials from a higher to a markedly lower stage during an hour of measurement. The conditions of the investigation were such as to rule out emotion or mental suggestion as responsible for the observed fall. Evidently, these studies lead toward the working hypothesis that muscular re-education might be an effective agent in many instances of arterial hypertension. This matter has been discussed previously.[7,8]

Technic of Muscular Relaxation

A technical method of training is commonly required if individuals suffering from "essential" hypertension are to be enabled to effect complete relaxation in tested muscles. Otherwise when such individuals are lying down or during accustomed work, the muscles usually display slight electrical action-potentials indicating the presence of a moderate degree of contraction, termed "residual tension." According to observations up to date, the falls in systolic and diastolic pressure are often most marked during periods when relaxation proceeds until "residual tension" disappears or diminishes, as indicated by action-potentials falling to zero or approximately so. Accordingly, training consists of two divisions. In the first, termed "general relaxation," the patient lying with eyes closed, is shown how to relax voluntarily most of the chief muscle groups of the body in a selected order, until he comes to be able to relax them more or less simultaneously. To accomplish this, it has been found necessary to cultivate the muscle sense, enabling him to determine for himself when and where skeletal muscle groups appear to be tense. Each period of instruction occupies one hour, but the patient needs also to practice daily for one or two hours if he is to acquire the requisite skill. During the first period of instruction, after lying quitely for several minutes, he flexes his left arm and is directed to observe closely the sensation in the contracting flexor muscles. This experience, it is agreed, is to be called "tenseness" not alone when it occurs in the left arm but also whenever it takes place elsewhere in the body. Following this observation, he is directed to discontinue the act of flexion and the term "relaxation" is introduced as meaning simply the negative of the experience previously termed "tenseness." This initial procedure and instruction are repeated sufficiently often until he is able to flex and to relax promptly, while reporting corresponding sensory experiences. It seems unnecessary minutely to repeat here what has previously been described regarding the principles and details of training.[9-10]

After the patient has learned to relax voluntarily, as shown by certain clinical signs as well as electrical measurements, the periods of instruction are directed toward producing neuromuscular relaxation more habitual in the sitting posture. This is the second division of training, termed "differential relaxation." In a series of hour-periods of instruction while the patient sits on a chair, the chief muscle groups of the body are contracted, commonly one group during each period, until the entire body has been covered. However, the contractions performed in the sitting posture and subjected to observation and practice are as a rule relatively slight, in order to cultivate the muscle sense more closely. In current practice, after a sufficient period of training, action-potentials from a muscle group such as the quadriceps femoris while the patient is engaged in reading should show marked reduction from their values found in similar tests before training.

Newer methods of physical therapy commonly require detailed presentation before they come to be understood. Accordingly, in the present article one case report is presented as typical of many others during the last ten years. In a later article, the results of a group of similar cases will be presented statistically.

Case Report

The patient, first seen in 1930 when 59 years old, was the president of a foundation with vast responsibilities, but was considering whether he should retire because of high blood pressure. Elevated blood pressure was first noted in 1912. Treatment was limited to progressive relaxation with no adjunct therapy such as medication, diet or change of daily occupations. Within less than two years, while he continued to work, his pressure returned to within normal limits for the most part (with occasional rises of transient

duration). The result evidently has been virtually equivalent to recovery. At the age of 69 (August 15, 1940), he is free from subjective symptoms and appears vigorous. His pressure (November 12, 1939), after about fifteen minutes sitting, is approximately 144 systolic and 96 diastolic.

His complaints in 1930 included "nervousness," "tenseness," excessive fatigue, moderate insomnia and occasional dizziness. "Excessive thinking" persisted during the evening and night, when fatigued. Sleep had been somewhat irregular for several years. He would frequently awaken at about four A. M. and would cogitate for perhaps an hour. If then he returned to sleep, he would awaken refreshed upon his customary hour of arising—about seven A. M. Nevertheless, he believed that as a rule he slept approximately six to seven hours per night.

A naturalized Englishman, married in 1900, he remained childless. One sister had angina pectoris (1930), another arthritis. One brother died of pneumonia, another of Hodgkin's disease. Death of the father was accidental. His mother died at 78 of unknown cause. He knew of no instance of tuberculosis, diabetes or goiter in the family.

During childhood, he had measles, mumps and frequent colds. His tonsils were removed in 1895, and sinusitis was cleared up in 1924 by simple suction.

He had not used alcohol or tobacco. He walked daily as a rule. While his physicians had not advised him to limit his food intake, he stated that he spontaneously avoided much red meat to avert obesity. Neither nerve sedatives nor blood pressure depressants had been prescribed for him.

In 1925, he was examined at the Hospital of the Rockefeller Institute of Medical Research. For the following notes, I am greatly indebted to Doctor Alfred E. Cohn.

February 25: Height 64.5 cm. Weight 70.7 kg. Electrocardiogram shows normal rhythm with a sinus tachycardia. R3 is of low voltage. Conduction time is .14 second. The T waves in lead 3 are negative. There is 1 left ventricular premature contraction. Blood pressure 142/100. *March 2*: Blood pressure 160/100. *March 4*: Basal metabolism = +12 per cent. Repeated examinations of urine and of blood, including complete counts, sugar and urea nitrogen: negative. Blood pressure: *March 3*, 150/95. *March 5*, 170/105. *April 28*, 160/90; one hour later 175/100; 5 minutes later 170/100; 5 minutes later 170/100. *May 2*: 170/100; 20 minutes later 170/100. *October 15*: 158/102. *November 20*: 164/98. O_2 capacity venous blood = 8.66 mM. hemoglobin = 104.7 per cent. Urine: 2 hour period: volume, 130 cc. per hour; blood urea nitrogen: 0.181 Gm. per liter; urine area nitrogen 3.97 Gm., urea index 56 per cent (low normal). Phthalein, 1st hour 71.4 per cent; 2nd hour 16.9 per cent. Total = 88.3 per cent for two hours. Urinary concentration and dilution tests: negative.

In July, 1929, he was examined at the Billings Hospital of the University of Chicago. For the following summary, I am indebted to Doctors Franklin McLean and Louis Leiter. Blood pressure elevation varied from 158 systolic, 100 diastolic to 180 systolic, 110 diastolic. The orthodiagram of the heart indicated a transverse diameter 14.5 cm. and a transverse arch 7 cm. (then interpreted as 40 to 50 per cent over-size). The pulse rate ranged from 80 to 120 during five days in the hospital. The electrocardiogram showed normal conduction time, P. R. interval .16, QRS .10 seconds, a slight S. T. depression in Leads I and II, Lead I showing some notching of the auricular wave. Fundus examination released normal discs, arteries slightly contracted, tortuous with slight A. V. compression. Eye grounds showed early retinal arteriosclerosis, no hemorrhages. The urine was of normal specific gravity without sugar, albumin, casts or formed elements of consequence. The blood urea nitrogen was 0.078 Gm. per liter. The urea index, 51.0 or 94 per cent of normal. The blood count showed 4,320,000 reds, 7,400 whites and 95 per cent hemoglobin. The Wassermann and Kahn tests were negative. X-ray films revealed a few teeth devitalized or with rarefaction at the roots. He was advised to continue his work, to rest one hour each afternoon and to restrict protein and salt moderately. In late August, after two months vacation, he stated that he was now free from precordial discomfort; but the blood pressure was still elevated, reaching 180 systolic and 104 diastolic. No observable reduction of blood pressure had followed the extraction of suspected teeth in 1930.

Upon examination, June 13, 1930, the patient had grayish hair, with partial alopecia and wore glasses. His manner was quiet, but he spoke somewhat rapidly and with great detail. Closer observation revealed slight but distinctive fidgets of hands or feet, as well as a somewhat excessive activity of the eyeballs and of the lids, particularly in the sitting posture. The pulse was regular, strong and 110 in rate, while the range in systolic blood pressure was from 175 to 185. The diastolic pressure was 96. His weight was 154 pounds, unclothed. In his mouth were plates in addition to twelve of his own teeth. The tendon reflexes were generally lively. In other respects the findings were either within normal limits or else resembled those recounted above for 1929.

An electromyogram was taken from the muscles which flex the right forearm during an hour when the patient was lying on his back with his eyes closed in an attempt to rest completely. This furnishes an index of the patient's neuromuscular condition at the time

of measurement, much as an electrocardiogram affords an index of the cardiac condition on a particular occasion. As described previously, the string galvanometer is employed in combination with amylifying units of special design. Electrodes consist of platinum-iridium wires, inserted one into the muscle tissue and the other beneath the skin in the olecranon fossa. Quiet is maintained and conversation is avoided.

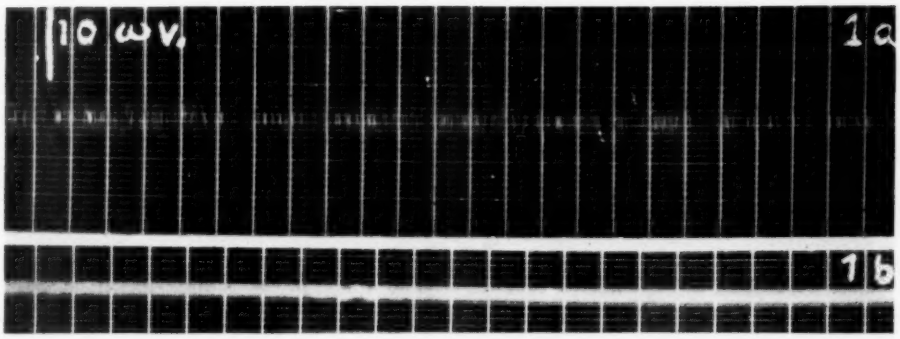

Fig. 1a. — Electromyogram before treatment, June 13, 1930. Typical sample, with electrodes in right biceps-brachial muscles. Action-potentials fluctuate in the neighborhood of 10 microvolts, a.c. Time lines = 0.2 sec.

Fig. 1b. — Control test. Under the same conditions, except that the input leads are short-circuited, the string is quiet.

The electromyogram (fig. 1) indicated a state of relatively high neuromuscular tension.* In the sample shown, which was fairly characteristic of the entire recording during a period of 50 minutes, the peak potential difference in the electrodes on the average per unit of time, 0.2 second, exceeds 10 microvolts, a.c. There are minutes during this period when the average is almost double that just stated, but nowhere is it less than 10 microvolts. This greatly exceeds the norm in individuals who do not have arterial hypertension and who do not exhibit signs of muscular hypertension or nervousness. In these individuals the average peak potential difference for a 50 minute period would appear to be under 1 microvolt a.c. as a rule.

Training in progressive relaxation was begun on June 13, 1930, following methods previously described. During the subsequent twelve months he was treated on about seventy days; but because of the urgency and importance of the case, two treatments often were administered on the same day. During the second year he was seen infrequently, as compared with the first.

Each period of instruction lasted about one hour and was devoted as a rule to one muscle group exclusively. The methods are not psychologic and do not include the attempt to convince the subject that he is improving. "Mental suggestion" is omitted deliberately, for the patient needs to be trained to depend upon himself—not upon the physician. In this, the procedure resembles any other training in physical education, including sports, such as swimming or golf. The patient practiced regularly about one hour after each meal. To secure time for the morning hour, he arose earlier than had been his custom.

According to recordings on September 7, 1930, he was becoming more relaxed than in June. Likewise the blood pressure reading on September 8 was 137/89—one of the lowest observed up to that date. The average pressure during September was 150/93; during June, 164/87. For two or three minutes, the microvoltage (mean peak) hovered near 10 (a.c.), but thereafter declined irregularly. The string was practically quiet (microvoltage considerably less than 1) during almost an entire 30 minute period (fig. 2a), excepting about two minutes during which the potentials varied considerably, sometimes exceeding 20 microvolts.

During a second recording on the same day the string was quiet for the first five minutes, then for the next six minutes the microvoltage varied up to about 10 (a.c.). In the following four minutes, the string became almost quiet again—with microvoltages below 1; while during the final 15 minutes he failed to relax at any time, with microvoltages approximately in the range from 3 to 5 (fig. 2b).

As seen in table 1, declines in blood pressure occur irregularly, marked by relapses or intervals of increase. The pressure evidently is lower on the average after treatment has been in progress as compared with levels before treatment. However, the figures fail to demonstrate a fall in pressure linear with time, while marked but transient rises of pressure are interspersed during the course of treatment and after. The blood pres-

* For this record (contrary to later custom), a high pass (130 cycle) filter was employed. This explains the high frequencies photographed, as compared with following figures.

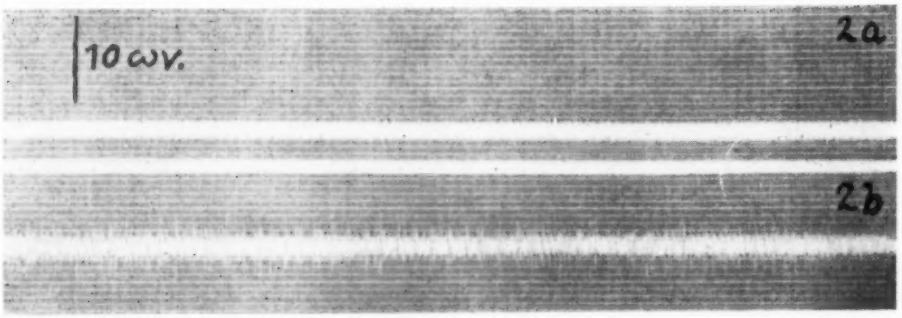

Fig. 2a. — After several months of treatment, September 7, 1930. This excerpt, which begins after five minutes of recording, is a fair sample during most of the first thirty minutes.

Fig. 2b. — Another excerpt, same date, after about twenty minutes of the second recorded period. This tracing is fairly representative of the last half of the second test.

sure after relaxation on some days is clearly lower than that before relaxation, but success in this respect is not attained always and on more days than not the later figure is the higher one. Probably the interpretation is that he succeeded sometimes and failed at others to relax residual tension during the periods, but that with considerable fluctuations from month to month, he became on the whole more relaxed. The considerations mentioned above make it appear reasonable to classify this case as only reltaively responsive to treatment in contrast with instances where reduction of pressure is secured early in the course of treatment and maintained more consistently.

During the following twelve months, the patient was treated on about twenty-three days. The tendencies toward slight frowning, wrinkling of the forehead and worrying seemed to diminish and his voice became more quiet. His pressure after a morning of hard work (November 16, 1930) was found within normal limits—140/84. On May 24th he stated that he was in "first rate condition." On August 4, he received bad news in a more relaxed manner, while his pressure (sitting) was 138/78.

The electromyogram of September 12, 1931 (fig. 3a) may also be compared with

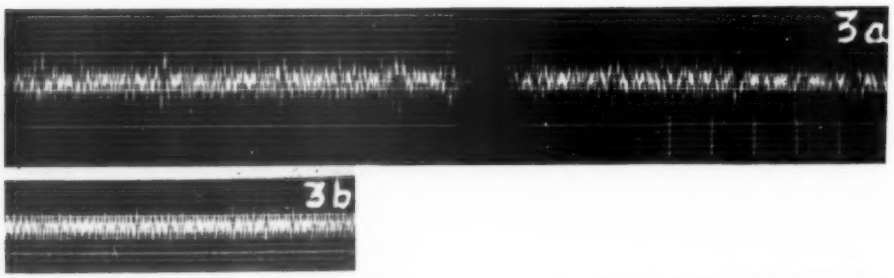

Fig. 3a. — After fifteen months of treatment, September 12, 1931. Excerpt beginning after about 27 minutes of previous recording. The tracings (2) represent forty seconds of time, since the intervening blank accounts for an interval approximately of seventeen seconds. 1 cm. = 1 microvolt (ω V.) a.c. in this and following figures.

Fig. 3b. — Short-circuit control test. At this high voltage-sensitivity, the string vibrates slightly but continuously, as here shown, even when a short circuit exists across the input terminals of the amplifier.

that of June, 1930 (fig. 1). The sample shown is a fair example of the entire record. Contraction voltages (action-potentials) are now greatly reduced; he relaxed more fully as here measured. Accordingly the instrument has been set at a much increased voltage sensitivity for this recording.

For the greater part of the recorded period (30 minutes), the potentials are considerably under 1 microvolt, a.c., almost nowhere exceeding this value. Accordingly, the greater relaxation manifested in the recordings of September, 1931, as compared with those of June, 1930 (before treatment was well under way) is evident, for the peak microvoltages per unit of time on the average are reduced more than 90 per cent.*

* Furthermore, in the recordings of figure 3 the high pass filter (130) was omitted. If, similarly, this had been omitted in the first recording (fig. 1), the peak microvoltages therein would, of course, have greatly exceeded 10, a.c. and the manifest reduction shown in figure 3 over figure 1 would be greatly increased. However, the two records have a feature in common, although much more marked in the earlier one: action-potentials persist throughout both, with relatively little variation from minute to minute. The muscular tension in both is relatively steady. That this is seen frequently in cases of "essential" hypertension will appear in a later article.

TABLE 1. — *Averaged Blood Pressures Before and After Each Treatment on Dates Shown. Beginning on November 13, 1931, Pressure Is Taken in the Sitting Position Only.*

Date		Before			After			Average Change		
		Pulse	Systolic	Diastolic	Pulse	Systolic	Diastolic	Pulse	Systolic	Diastolic
6/ 3/30		108	163	93	100	156	95	— 8	— 7	— 2
6/24/30		120	171	95	114	163	96	— 6	— 8	+ 1
6/27/30		114	157	83	.....	146	87	.....	—11	+ 4
7/ 1/30		104	140	82	.....	128	74	.....	—12	— 8
7/ 3/30		105	146	86	.....	135	76	.....	— 9	—10
7/ 6/30		98	158	99	90	154	101	— 8	— 4	+ 2
7/ 8/30		90	145	103	95	145	100	+ 5	0	— 3
7/15/30		102	137	89	83	141	86	— 9	+ 4	— 3
7/17/30		104	151	95	108	158	99	— 4	+ 7	+ 4
7/22/30		120	167	94	108	160	96	—22	— 7	+ 2
7/25/30		132	163	94	129	163	106	— 3	0	+12
7/29/30		116	176	96	108	170	101	— 8	— 6	+ 5
8/ 1/30		108	155	95	92	147	89	—16	— 8	— 6
8/ 5/30		114	164	94	120	169	100	+ 6	+ 5	+ 6
8/ 8/30		116	166	96	111	161	98	— 5	— 5	+ 2
8/12/30		108	177	126	108	172	118	0	— 5	— 8
8/15/30		108	145	96	117	156	96	+ 9	+11	0
8/17/30		.....	144	96	.....	156	98	.....	+12	+ 2
8/18/30		115	140	95	108	145	99	— 7	+ 5	+ 4
8/22/30		96	157	94	108	166	94	+12	+ 9	0
8/26/30		104	152	90	116	158	98	+12	+ 6	+ 8
8/26/30		104	161	93	118	163	101	+14	+ 2	+ 8
8/26/30		98	156	87	108	162	96	+10	+ 6	+ 9
9/ 8/30		93	137	89	108	156	94	+15	+19	+ 5
9/12/30	(AM)	81	138	96	92	151	94	+11	+13	— 2
9/12/30	(PM)	108	149	83	104	160	92	— 4	+11	+ 9
9/16/30		108	162	101	102	169	100	— 6	+ 7	— 1
9/23/30		.....	163	95	.....	160	97	.....	— 3	+ 2
11/13/30		94	138	94	94	146	96	0	+ 8	+ 2
11/15/30		80	140	83	82	138	90	+ 2	— 2	+ 7
12/29/30	(AM)	90	152	88	85	148	89	— 5	— 4	+ 1
12/29/30	(PM)	90	163	92	87	160	82	— 3	— 3	—10
1/18/31	(AM)	90	142	.....	87	139	.....	— 3	— 3	.....
1/18/31	(PM)	84	152	86	85	152	78	+ 1	0	— 8
1/19/31		81	140	84	70	130	76	—11	—10	— 8
3/20/31		84	152	86	81	148	84	— 3	— 4	— 2
3/21/31		74	140	88	71	140	90	— 3	0	+ 2
3/24/31	(AM)	91	156	107	84	152	106	— 7	— 4	— 1
3/24/31	(PM)	95	156	88	98	158	86	+ 3	+ 2	+ 2
3/28/31		92	164	92	105	164	84	+13	0	— 8
7/10/31		84	162	94	90	166	98	+ 6	+ 4	+ 4
7/17/31		85	154	94	81	150	90	— 4	— 4	— 4
7/21/31		84	148	94	90	154	96	+ 6	+ 6	+ 2
7/24/31		84	164	106	93	170	100	+ 9	+ 6	— 6
7/28/31		76	146	76	84	146	78	+ 8	0	+ 2
8/ 4/31		87	138	78	96	152	94	+ 9	+14	+16
8/11/31		76	142	90	84	168	100	+ 8	+26	+10
8/21/31		96	146	88	90	152	80	— 6	+ 6	— 8
8/28/31		82	160	84	84	165	87	+ 2	+ 5	+ 3
9/11/31		88	164	118	96	166	98	+ 8	+ 2	—20
9/18/31		100	180	104	100	178	102	0	— 2	— 2
10/18/31	(AM)	84	148	94	85	146	95	+ 1	— 2	+ 1
10/18/31	(PM)	76	140	90	68	140	86	— 8	0	— 4
10/19/31		100	155	86	89	150	96	—11	+ 5	+10
10/19/31		76	140	94	69	144	90	— 7	+ 4	— 4
10/20/31		88	158	90	80	152	86	— 8	— 6	— 4
12/29/31		104	174	100	96	166	100	— 8	— 8	0

The record of September, 1931, differs from that of September, 1930, chiefly in that periods of marked contraction voltages (corresponding to nervous excitation found in two sections of the record of September, 1930), are absent in the later test. News of the death of his predecessor disturbed him during this month, possibly accounting for higher pressure levels at this time.

During September 12 to December 29, 1931, he continued at his work, but received treatment on several days of September and October. The blood pressure levels, now recorded in the sitting posture, show considerable fluctuation, but systolic values in the 140-160 range are in the majority. Consistently, the action-potential record indicated an ability to reach and to maintain a greater degree of relaxation than previously registered.

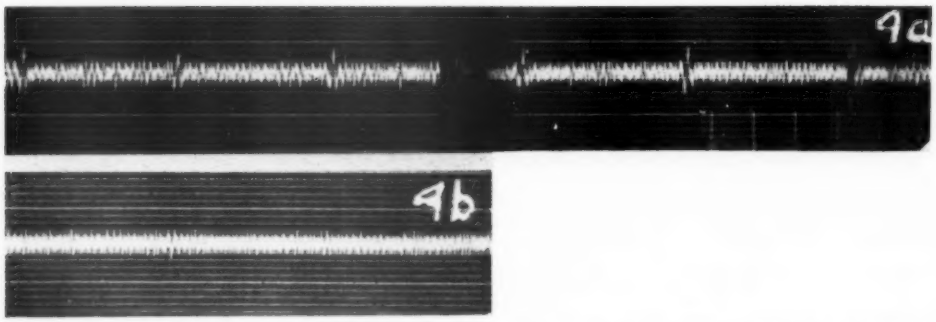

Fig. 4a. — Three and a half months later, December 29, 1931. Similar excerpt, beginning at about 13 minutes, showing the lowest action-potentials recorded up to that date. (Recurrent longer lines are electrocardiograms.)

Fig. 4b. — Short-circuit control test. Compare with 4a, where vibrations are a little greater.

This is illustrated in figure 4a showing the lowest potentials recorded up to that date (December 29, 1931). Relaxation, at times, is almost complete in the muscles tested, for action-potentials have fallen to only a minor fraction of a microvolt. With scant exceptions, the potentials nowhere exceed 1 microvolt a.c. and for the most part do not exceed 0.5 microvolt a.c. Accordingly decline of blood pressure apparently has taken place with the cultivation of a more habitually relaxed state. This agrees very well with the patient's personal observations of diminished nervousness, anxiety and fatigue and of increased ability to work.

Another objective check is the test for promptness of relaxation upon hearing a signal sound (the click of a telegraph key). In addition, the test used here permits us to ascertain, in a particular case, at least, whether the patient is learning successfully to relax mental operations, which is important if he is to become able to keep his mind more markedly free from worry and other disturbing states.

As shown in figure 5a, upon the sound which, according to agreement, is the signal to

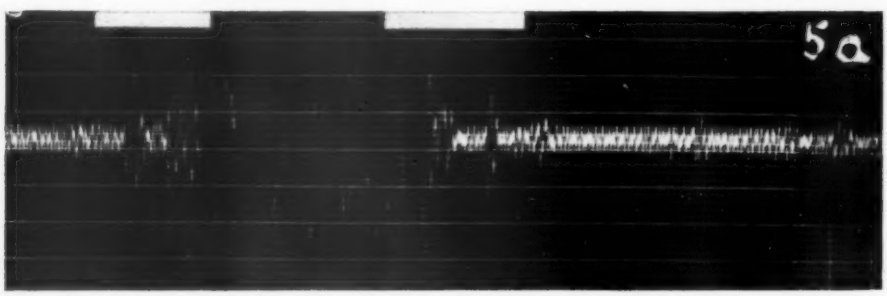

Fig. 5a. — Test of promptness of relaxation of a mental operation, September 12, 1931. Upon hearing the first click of a telegraph key, the patient imagines that he is lifting a ten pound weight in his right hand. The occurrence of action-potentials in this tracing reveals how such acts of imagination consist in actual, minute contractions in the right arm flexors. These action-potentials cease promptly, returning to former levels, following the second click, which is the signal to relax any muscular tensions present. (Signal marks at top of photograph: left margins indicate clicks.)

imagine lifting a ten pound weight in the right hand, the right biceps-brachial muscles promptly evince a volley of action-potentials. The latent time is about 0.2 second. Almost as promptly, following the second signal sound, signifying that he is to relax at once, diminution of action-potentials sets in. Within 0.6 second, he has become quite as relaxed as before the first signal.

As a control test, the same conditions prevail, except that the patient is to imagine lifting the weight in the left hand (instead of in the right). This time no volley of action-potentials from the right arm muscles follows the signal (fig. 5b).

It will be noted that he had not learned to relax his right arm musculature completely to zero, as has been shown to occur in many or most persons trained to relax.[11] A slight tonus persisted in this instance but its mean (peak) value was considerably under 1 microvolt. The ability to diminish this tonus somewhat further at times is manifested in later recordings (December 29, 1931). In figure 5c, following the signal to relax, diminished string vibrations can be discerned, as compared with the same section in figure 5a; besides, he has apparently learned to relax somewhat more promptly upon signal. (Also, he shows more prompt action after the first signal in this test.)

The course of treatment was approximately completed in 1931, except for subsequent infrequent treatments. While the blood pressure remained reduced toward normal levels as a rule, there were noteworthy exceptions marked by sharp rises in the diastolic as well as in the systolic figures; but the rises were not long sustained. During one such rise, April 26, 1932, the patient commented that his condition was now the best it had been in many years, for he had no ill symptoms and could work with his full energies. My notation at this time is significant: "When most worried about his condition, his pressure has generally been about normal. Now, when believing himself in the best condition, his pressure is high."

This comment illustrates that the patient's improvement does not depend upon his "psychology." Obviously, the method of relaxation is *not* a psychologic approach.

The systolic readings on August 2 of the same year were relatively high, also. The pulse rate was 116, while the pressure was 198/94. The patient stated his belief that the readings were high only because of his concern over the examination, for at other times he continued to feel free from nervousness, quite different from what he had felt during three years prior to the present treatment.

In February, 1933, following a sudden attack of acute abdominal pain, a ruptured appendix was found at operation. Before the operation the pressure was but 158, systolic; on the day following it was 144, systolic and 90, diastolic. Accordingly the data did not suggest that the focus of infection then discovered had much to do with raising the pressure in this patient. His behavior was relaxed before as well as after the operation;

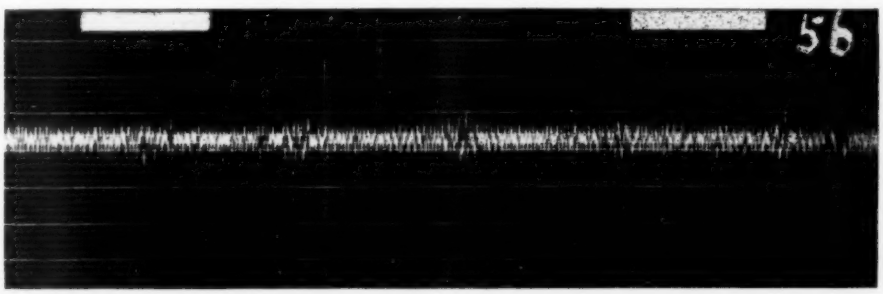

Fig. 5b. — Control test is negative, when he imagines lifting the weight in his *left* hand. (Electrodes in right arm flexors.)

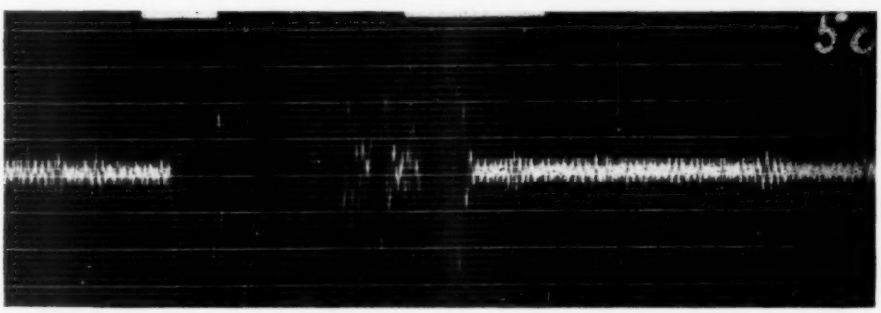

Fig. 5c. — Same test as 5a at a later date, December 29, 1931. Relaxation is somewhat more prompt and more nearly complete.

and to this he attributed his ability to withstand the strain. Convalescence was uneventful otherwise.

During 1932 and 1933 a little pus was expressed at times from one tonsil. In May, 1934, he was re-admitted at his own request to the Rockefeller Institute to determine the advisability of tonsillectomy. I am again indebted to Doctor Alfred E. Cohn for a summary of the essential findings: Slight hypertrophy of tonsillar tags. The lungs clear. Heart: Apex impulse 11 cm. to the left in the 5th interspace. A faint, short systolic blow in the 4th left interspace. Moderate accentuation of the aortic second sound. Blood pressure: 235/120 falling in ten minutes to 215/110. Slight peripheral arteriosclerosis—tortuosity of the brachial artery. The vessels of the fundi showed slight thickening. There was no compression of the veins. *Electrocardiogram*: No significant change from the previous examinations. The film of the heart superimposes fairly accurately upon the ones taken in 1925. Urea clearance test: 104.3 and 90.8 per cent of normal in two tests. Concentration test:

Time	Amount (cc.)	Specific Gravity
9:35 p.m.	158	1013
9:35 p.m. to 7 a.m.	154	1018
7:00 a.m. to 10 a.m.	76	1015
10:00 a.m. to 1 p.m.	74	1017

After 36 hours in bed the blood pressure fell to 190/100.

It seems likely (as the patient believed) that the rise of pressure noted in May was of emotional origin, due to the fears regarding the results of examination. At any rate the rise proved of transient duration (table 1).

Whatever the other accountable factors, perturbation over having his pressure taken seemed to explain in part at least a rise noted on August 26, 1937. The figures taken in the sitting posture varied considerably. Initially 204 systolic and 108 diastolic, a fall to about 170/104 was observed in about 15-20 minutes while conversation continued and subsequently at levels of 150 or below (systolic) and 100 diastolic. He reported that the range of the systolic readings recently had been 134-169. (Twitching of the right eye-lid had set in, which he described to an admitted error of an optician in reducing a lens).

On December 3, 1937, he seemed very well and his systolic pressure, sitting, was initially 172, later remaining about 154, with diastolic values 103-108.

On November 10, 1939, the patient looked very well, with good color, bright eyes, normal skin turgor, and alert mien. A small muscle beneath the right eye showed fibrillation at times. Otherwise he seemed free from any symptom of nervous hypertension. He stated that he had been exceedingly well and had continued to work on special projects, after his retirement according to the age rule at 66 years of age. The blood pressure immediately after sitting down was 170/96, falling within a few minutes to 150 systolic, while later readings were approximately 144/98. He added that he had been "rushing" unusually on this day and believed that as a rule his systolic pressure probably would be considerably lower than the present figure. Recent eye-ground examination was reported normal for his age.

Summary and Conclusions

Whatever will ultimately be disclosed concerning the physical and perhaps chemical pathologic state presumably existing in patients with "essential" hypertension, the actual level of their blood pressure at any time appears to depend considerably upon nervous influences. Action-potential studies have indicated that both systolic and diastolic pressure are functions which vary within limits with the magnitudes of contraction voltages in the skeletal musculature. As illustration and detailed test in a particular clinico-physiologic study, a patient, aged 59 at the beginning of this study, with a history of at least five years previous heightened pressure was selected, particularly because his previous history was on record in the thorough examinations of two institutions.

Action-potential measurements in this individual disclosed the existence of a moderate grade of more or less continual contraction in his skeletal musculature which, in contrast with many normal individuals, persisted even when he tried to rest and relax. When daily habits of muscular relaxation were cultivated, action-potential records confirmed that muscular training was effective. After two years the patient was practically discharged (but was able to continue at his work actively) and ten years later he is vigorous and is free from symptoms which troubled him for a decade before treatment. Since the pressure has been reduced for the most part to within normal levels (with transient relapses), the evidence indicates that in this case a significant etiologic factor of the hypertension termed "essential" could be sought in the existence of neuromuscular hypertension.

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(*Concluded on page 694*)

RADIO INTERFERENCE PROBLEMS FROM OPERATION OF ELECTRO-MEDICAL APPARATUS *

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WASHINGTON, D. C.

It is a privilege and a pleasure to meet with such a distinguished gathering and discuss radio interference problems resulting from the use of electro-medical apparatus. Before I go into those problems it might be well to mention briefly the radio services in operation today, which must be protected against interference.

When we speak of radio, most people immediately think of broadcasting. This is easily understood because nearly 50 million broadcast receivers are serving the American public. In addition to broadcasting, there are many thousands of radio stations of other classes which are operating for the benefit of the general public. These include the services which are maintained primarily for the protection of life and property, such as ship and coastal stations in the maritime service, aircraft and aeronautical stations used as air navigation aids and for the handling of weather reports and other vital information. Also, several thousand police stations are in daily operation for the handling of law enforcement matters. Other safety services include forestry stations used in connection with the protection and preservation of our national forests, and "special emergency stations" set up by various public utilities throughout the country for emergency communication when wire lines or other means of communication fail.

Of paramount importance, particularly at this time, are the defense communication services operated by the Army, Navy, Coast Guard, and other governmental agencies. The general public relies upon the vast system of domestic and international radio circuits for dispatching messages concerning the conduct of their personal business. In addition, radio is used by more than fifty thousand amateurs licensed by the Federal Communications Commission who have already won great credit and admiration for their experimental contributions to radio, for the training of operators to help fill our defense needs, and for the handling of emergency communications during periods of disaster when wire lines are disrupted as a result of earthquake, hurricane, flood or other catastrophe.

Types of Radio Interference

Interference is, of course, the problem child of radio. If it were not for interference, one of the principal reasons for the government regulation of radio would be lacking.

Radio interference is of three kinds. Except under special conditions, radio stations can interfere with one another unless they are assigned separate frequencies — that is, separate highways in the ether. This kind of interference is taken care of through government regulation and international agreement. Every station is assigned a specific frequency or channel and is required to operate within this channel. It must not deviate from its frequency beyond certain limits. The signals, in other words, must ride on the right side of the road.

* Read at the Nineteenth Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, September 2, 1940.

The second type of interference is caused by nature — thunder storms or electric discharges, static or atmospheric noise, as we call it. During local thunder storms the radio set is usually out of commission but other storms of far distant origin still play a part because these electrical discharges are transmitted by radio. In this connection, it is interesting to know that there are some 1800 thunder storms in existence in all parts of the world at any one time. So there is always a varying amount of interference or atmospheric noise present in radio reception, and it appears all over your dial. We overcome this type of interference in large measure by assigning sufficient power to radio stations to override the noise.

The third type of interference is industrial — electrical or man-made. It is caused by electric machines used in the industry or the home, such as oil burners, electrical razors, automatic sign flashers, and the like. Automobile ignition and electric railways are other producers of interference. Fortunately, this third type of interference travels only a very short distance from the source. It has been possible to control this type of interference to a large extent through cooperation between manufacturers, radio operating companies, and the user of the equipment.

The interference caused by diathermy equipment appears in a class of its own. True, the apparatus is an electric machine and it is not used for communication purposes, but to treat patients, to relieve human suffering and to save lives. However, it cannot be classed as an ordinary electric machine similar to many of the thousands in use in the electrical industry. Because of its design and the manner in which it is used, it is in fact — though not intended as such — a radio transmitter of considerable power utilizing an effective radiation system, operating in the most useful regions of the radio spectrum. It is not only capable of interfering with radio reception but in many cases is actually now doing so.

I wish to emphasize that the Federal Communications Commission recognizes the importance of electro-medical apparatus to the medical profession in the treatment of human ills. As a matter of fact, the Inter-American Radio Communications Arrangement signed at Santiago, Chile, in January of this year, specifically states that the use of diathermy apparatus has an important place in therapeutics, surgery, and industry. The immediate problem, therefore, is how may the public enjoy the benefits of radio communication as well as those resulting from the use of electro-medical apparatus without conflict between these services.

The Commission has been studying this problem for several years and has received excellent cooperation from the Council on Physical Therapy and other interested parties. A number of states and municipalities have enacted statutes and ordinances to deal with the subject. However, the general problem of interference has been approached by the Commission from the point of view that the public as a whole will be best served through cooperation in the industry. The Commission believes that through further cooperation it will be able to adopt standards of good engineering practice to guide manufacturers and users of electrical equipment and thus prevent radio interference.

Effect of Diathermy Interference

The serious nature of diathermy interference was first brought to my attention in 1935 when commercial and government communication agencies began to experience interference on the high frequencies used for long distance communication. The disturbances were at first attributed to stations operated by persons under the jurisdiction of foreign governments. The severity of the interference increased rapidly and agencies such as the Signal

Corps of the Army, the Navy, and the commercial operating companies, cooperated with the Federal Communications Commission in an extensive search for the source of the interference. The signals were observed to shift from one spot on the dial to another without, of course, any call signal or other identifying characteristics. Observations indicated that the signals emanated from points far removed from the receiving stations. An investigation finally disclosed that the interference was caused by diathermy machines operated in medical centers and offices of private physicians. Radiations from one of these machines located in the vicinity of Boston were controlled by an ordinary telegrapher's key and the signals thus emitted in the international Morse code were easily read in Washington, D. C., and at Great Lakes, Ill. Subsequent tests of a machine located in Schenectady, New York, revealed that it was capable of interrupting communication in Washington, Detroit, Grand Island, Nebraska, New York City, and other widely scattered points.

Since that time interference has rapidly increased as more and more diathermy machines have been brought into use by the medical profession. We know, from the nature of the complaints received, that diathermy equipment is the principal cause of interference. Sometimes the complainants have been able to locate the source of the interference and have gotten together as a group to complain to the Commission. They are, of course, very concerned at the loss of their favorite programs and want something done about it right away. The doctors also write in, since it is not to their interest to be held responsible for the loss of radio programs.

But this local interference in the broadcast services is not the greatest cause for concern in this problem. As I have previously mentioned, the transmissions from diathermy machines are capable of being received across the continent and even across the ocean. The frequencies upon which they operate are used by the national defense and safety services. Interruptions of these services may jeopardize life or property, or seriously affect the nation's interests.

Observations made by the Commission in 1937, revealed that the interference caused by diathermy machines on frequencies used for long distance communication, varied all the way from 10 to 82 per cent of the channels in use. In one band, 12-13 megacycles, used for international communication, 82 per cent of the channels were affected. Communication companies appeal to the Commission repeatedly as being their only source of relief from these interruptions in their service. Municipalities, as many as thirty at a time, have also petitioned the Commission for assistance in the protection of their police services.

Just one more point I would like to make here regarding the extent of this interference. We have in the radio industry two rapidly growing services that are likely to contribute very substantially to the public's benefit. These are television, and aural broadcasting combined with facsimile broadcasting, employing the new system of frequency modulation. Each of these new services must operate on ultra-high frequencies above 40,000 kilocycles. On the possibilities and potentialities of these services I need not dwell, but the fact remains that they have made remarkable strides and there is every reason to believe that they will soon be firmly established in our homes just as standard broadcasting is used today.

With this new system, called "FM broadcasting," we will have gone a long way toward overcoming one of the most unruly types of interference with which we have had to deal, namely, atmospheric. Diathermy interference will likewise be minimized or eliminated. There are many who live in rural areas who have never experienced real good radio reception. They are

so situated that they can only receive weak signals accompanied by static. We now have the opportunity to furnish these people with the same high quality noise-free radio programs that are often enjoyed in the large cities. But here again we are liable to collide with diathermy interference.

Any curtailment of diathermy apparatus would cause great hardship to many sufferers and would prevent the saving of many lives. No one would suggest such a step. On the contrary, I for one am anxious to encourage the use of diathermy equipment. Diathermy, like radio, is a safety service. It is used by physicians and surgeons in many ways to combat disease and for surgical purposes. In the hospital it has become an indispensable tool. We have been informed that there are thousands of therapeutic departments in hospitals in the United States, all of which possess one or more diathermy machines, and there are thousands of privately owned machines being operated by physicians in this and other countries. We would no more want to prevent the use of these machines than we would think of endeavoring to curtail the activities of the doctors themselves. But we are confronted with a very serious problem. Two safety services — diathermy and radio. It is a question of live and let live. We must find a way in which each can get along in the presence of the other.

I think I have made it clear that the reason the operation of diathermy apparatus affects radio reception is because the machines are essentially radio transmitters. The radiation which results in interference is not essential for therapeutic purposes and may be regarded as a by-product of the means used to attain the objective. It can, however, be eliminated or minimized if reasonable methods are employed.

Solution of the Problem

From an engineering standpoint, the solution of the problem is simple. While economic factors are important, they are not of such great importance as to be regarded as being unreasonable from the standpoint of cost to the users of therapy apparatus.

In those cases where it is necessary to take the apparatus to the patient, in circumstances where screening the room is not practicable or advisable economically, or, if for any other reason entire screening of the patient and the apparatus is not possible, it would appear that the only solution would be to use apparatus with a restricted frequency band of omission which does not extend over more than one communication channel. Great care should be exercised in the selection of the channel to make certain that no interference will result to radio reception.

This problem was considered in detail at the Inter-American Radio Conference which was held in Havana in 1937, and again at a similar conference in Santiago, Chile, in January of this year. It is significant that the question was an important topic for discussion at these meetings. We realize the international aspect of the problem. For example, the diathermy machines in Mexico or in Canada cause interference with reception in the United States, and vice versa.

A report prepared by the Canadian Delegation and adopted at the Havana Conference, gives the results of a very comprehensive study of diathermy interference and of the most effective and economic methods of suppressing it. All of the details as to the different kinds of shielding, their costs, and the manner in which they may be applied to rooms, walls, doors, etc., in hospitals and offices are given in this survey.

It was my good fortune to attend these conferences. The very large service being rendered to the public by the medical profession through the

use of electrotherapeutic apparatus, I can assure you, was fully appreciated at these conventions and there was no indication of a desire on the part of anyone to deprive the public of such benefits. It was realized, however, that the interference was extensive at the time, that it was increasing rapidly day by day while a practical means of suppressing it was available.

The representatives of the American countries agreed at Santiago that their respective countries should adopt measures to suppress or alleviate, insofar as possible, interference caused by apparatus or equipment which may generate or radiate radio frequency currents capable of interfering with, or adversely affecting, the reception of radio transmissions. In this connection, the following is quoted from the annex to the Inter-American Radiocommunications Arrangement:

All diathermy machines designed for the same service can operate on the same frequency without impairing their usefulness, since their operation is not affected by radiation from other machines. Operation on a specific frequency with a very close frequency tolerance is practicable, with little added cost. It is understood that the present design of diathermy equipment has to a great extent gravitated to frequencies above approximately 12 megacycles, hence it is recommended that the subscribing countries consider requiring all diathermy machines to use not more than two frequencies in harmonic relation above 12 megacycles which will not interfere with existing radio assignments. The harmonic relationship between the two frequencies provides a further guarantee against interference to radio communication.

Standards of good engineering practice are believed to be practicable at the present time and consideration of the adoption by the governments of such standards at the earliest practicable date is recommended. The standards should include the following subjects:

(a) Frequencies to be used.
(b) Automatic frequency control.
(c) Frequency stability.
(d) Type of emission.
(e) Maximum power output.
(f) Harmonic radiation to be effectively suppressed.
(g) Internal circuits to be effectively shielded.
(h) Radiation from power supply connection to be eliminated.

Where diathermy apparatus does not comply with the standards which may be adopted by the subscribing countries they should consider the desirability of requiring such apparatus to be operated in a properly shielded room.

There has been splendid cooperation among all concerned — the manufacturers of the apparatus, the medical profession, the government, commercial agencies whose radio services are affected, and the general public. So far as I know, the medical profession has not agreed on the most effective region of the radio spectrum for diathermy treatments. When this decision is made it will be our first task to find a suitable frequency for diathermy operation. The provision which must then be met insofar as the apparatus is concerned, should be arrived at by cooperative efforts on the part of the government and other interested parties. You may be sure that the Federal Communications Commission stands ready to assist, and is planning to call a conference for this purpose in the near future.

Discussion

Dr. John S. Coulter (Chicago): The medical profession was pleased to hear Mr. Jett representing the Federal Communications Commission assert that "any curtailment of diathermy apparatus would cause great hardship to many sufferers and would prevent the saving of many lives" . . . "and that: No one would suggest such a step."

I should like to discuss the experiments related by Mr. Jett in which radiations from a diathermy machine in Boston were intercepted at Washington, D. C. What appears to be the same experiment referred to by Mr. Jett as illustrating the long distance interference by short wave diathermy was published in the February, 1936, issue of the technical journal "Electronics." A photograph appearing therein shows the cable of the machine laid on the floor in an open loop some six feet long. No dissipative load or patient was at-

tached. While no doubt exists that as operated in the experiment the reception could be clearly heard at several distant points, yet operating it so as to cause maximum radiation is in effect making a broadcasting station out of it and not characteristic of that occasioned when treating a patient.

An experiment was conducted by the Armour Research Foundation, Chicago, to determine whether or not long distance interference would take place by short wave diathermy under treatment conditions. Several hundred physician radio amateurs were invited to listen for keyed emissions from short wave diathermy apparatus at prearranged intervals. The approximate frequency was given and a request made to report back the code letters when heard. All tests were conducted under treatment conditions at maximum tolerance of the patient. Fifteen transmissions of one-half hour each over four different days were made on a variety of frequencies and not one of the 21 observers who reported back stated that he heard any of the transmissions. Fourteen of these observers were well outside of the skip-distance.

In another experiment conducted by the Armour Research Foundation, keyed transmissions were sent from various locations from both outside and inside the skip-distance, and listened for by research workers at the Foundation. No identifiable signals were heard during any of five half-hour transmissions from locations outside the skip-distance nor from either of the two transmissions made inside the skip-distance. All of these tests were conducted under actual treatment conditions.

In pointing out the percentage of communication channels interfered with, Mr. Jett did not point out the degree of this interference. A report to the Federal Communications Commission by T. G. Miller of Electrical Research Products, Incorporated, dated June 28, 1939, states that the average field strength of signals attributed to diathermy is about one one-hundredth of the average field strength of the typical communication signal. This reference further finds that on an average less than one-half minute in every 24 hours of actual circuit operating time is lost because of interference attributed to diathermy apparatus. This report also shows that the time lost due to other causes is over twelve times that attributed to diathermy.

The Armour Research Foundation made a comprehensive investigation of the problem of shielding. It found that if a room were properly shielded it can be 100 per cent effective in the prevention of the escape of radio energy. However, the construction of such an installation requires a very considerable amount of engineering ability and it is thought that this would not be available in the majority of instances where screening might be attempted. The necessary cost of several hundred dollars in most cases rules out this remedial measure and such a solution is regarded as both economically and technically impractical.

Mr. Jett states that where screening is not possible the only solution would be to use apparatus with a restricted frequency band of emission which does not extend over more than one communication channel. This would seemingly indicate that he suggests that diathermy machines be made to conform to the same frequency tolerance as the communication equipment; namely, plus or minus 2/100 of 1 per cent. This would tend to make diathermy apparatus sell at a somewhat comparable price and require comparable service to that of complex communication equipment maintaining those tolerances and of the same power. Such narrow restrictions as to stability when short wave diathermy machines are used appear to be particularly arbitrary in view of the fact that very wide regions in the spectrum have been assigned to television and amateurs.

The result of Mr. Jett's idea of shielding or of restricting the frequency band of emission to only one extremely narrow communication channel practically will add much to the initial purchase price of the machine and greatly increase the difficulty of practical operation.

We as physicians are pleased to hear that with the new system called FM broadcasting, diathermy interference will be minimized or eliminated. This is particularly pleasing to us because although the statement is made that "from an engineering standpoint the solution of the problem is simple" the Council on Physical Therapy of the American Medical Association and the Committee on Radio Interference of this Congress have asked manufacturers of equipment and radio engineers to submit to us for physiologic tests a machine that will conform to the standards of good engineering practice as suggested by the Commission. This request has been made more than a year ago and no such outfit has been submitted.

The medical profession is worried about the cost of diathermy apparatus conforming to the suggested engineering practice. The manufacturers of such apparatus assure us it will cost three times the present price. I was in the government service for ten years and requisitioned the machines I needed without worry about costs. Now I have to spend the money I earn and I assure you that a machine that costs many times the present price will be a hardship. The manufacturers maintain that this high cost is necessary.

It is believed that the medical profession will agree that wavelengths approximating 24, 12 and 8 meters will serve effectively for all known and established short wave diathermy applications. Physicians likewise are willing and anxious to cooperate with the Federal Communications Commission.

Dr. Norman E. Titus (New York City): I don't know whether Dr. Krusen has a report here or not, but I sent him some observations I made with Dr. John V. Hogan, one of the research engineers of the Stromberg-Carlson Company of New York on facsimile reception and transmission. His office is eleven floors below

mine, at 730 Fifth Avenue, New York, and with a special staff of engineers he tested whether the different machines in my office, in the same building, interfered with his facsimile reception eleven floors below. We used a 100-meter diathermy machine, with and without a load, a static machine, grounded and ungrounded, and a galvanic current with a motor. None of the emissions from any of those appliances caused any interference with facsimile transmission eleven floors below, in the same building.

Dr. Hogan gave me a letter to that effect, which I think I forwarded to Dr. Krusen to file, showing that that close by there was no interference with facsimile reception.

Mr. Howard A. Carter (Chicago): Fifty years ago, the man on the street would have ridiculed anyone believing that intelligence could be transmitted through a medium which cannot be seen, heard, tasted, felt, or identified by any of the naturally endowed senses. Twenty-five years ago one would not have believed that specialists in radio which is now a major branch of the electrical engineering profession, would be discussing the allocation of highways in space previously regarded as free property. This space is now valuable and eagerly sought. To regulate it for the common good, the Federal Communications Commission has been established to study and investigate the problems arising and to suggest laws governing regulation.

When I was a radio novice, or a "ham," I used a spark gap coil transmitter to drive a Morse code signal through space. Whether I operated on a certain frequency was not my concern. I was interested only in making the signal heard several miles away. If it was necessary to have a license then, I did not know it; nor did any government agency take me to task for not having one. I am reminded of the conditions once existing on the vast plains in the early West, where the ranchers allowed their cattle to roam and graze. With the coming of other domestic animals, barbed wire and sheriffs, conditions changed and government regulations were necessary. An analogy can be drawn now between the conditions arising in the radio part of the electromagnetic spectrum and the early conditions in the cattle country.

When it became apparent that regulation of wavelengths for diathermy units was necessary, it is a small wonder that the physicians and manufacturers of electro-medical equipment were perturbed. They had no desire to use any of the precious medium as a channel of communication. If equipment were made so that this energy did not radiate, it would be a benefit to the physicians and manufacturers because the apparatus would be more efficient. The energy radiated is really lost energy, so far as concerns its utilization for treatment of disease.

Two means of controlling this situation are mentioned by Mr. Jett. One is the assignment of certain frequency channels for electro-medical equipment and the other, the screening of the treatment room. Both of these involve extra expense for the medical profession, which regards the whole business as a nuisance.

It is the material that is left out of Mr. Jett's paper that I desire to discuss. In my opinion, the address would have been much more informative if the author had given the wavelengths or frequency channels allocated by the Federal Communications Commission on which the diathermy machines may operate freely without interfering with radio communications. The tolerance of frequency stability might also have been given. Mr. Jett is the Chief Engineer and not the Commission, and naturally he can not make these regulations. Probably the Commission is not ready to allocate these frequencies, since sufficient information is not available. In my opinion, the profession and the manufacturers would feel more reassured if this important problem were solved.

It is the opinion of the Council on Physical Therapy that at any frequency between 10 mc (30 meter wavelength) and 50 mc (6 meter) clinical heat may be administered to the tissues, and in the light of available evidence, any one frequency is as good as another. Whether the application be pads, coils or air-spaced electrodes has nothing to do with the final clinical result, although coils appear to work better on the long wavelengths and pads on the shorter.

The next steps, therefore, which should be carried out by the manufacturers of therapeutic equipment lie in the direction of securing scientific evidence to prove which frequency will give the most satisfactory therapeutic performance and of determining whether or not the completed apparatus will maintain its stability within the limits already prescribed for radio broadcasting stations, used by any physician anywhere. Research in this field may show that a short wave apparatus that will give satisfactory therapeutic performance on a tolerance of .02 per cent can be constructed economically. It is questionable whether diathermy based on automatic frequency control can maintain the tolerance of this order and still meet the demands of the medical profession. If it is impractical to construct an apparatus for these tolerances the Federal Communications Commission might be consulted with the idea of giving further consideration toward broadening their views on these requirements.

The amateur and television interests, for example, are allocated relatively wide bands in which many channels can freely operate without interference with one another. It would seem, therefore, that the Federal Communications Commission might see fit to allocate not a single but several channels; for example, at three different places in the electromagnetic spectrum.

The splendid spirit of cooperation prevailing in the tone of Mr. Jett's paper is most assuredly appreciated by the members of the medical profession.

Dr. Richard Kovács (New York): I would like to relate some of my own experiences with radio interference by electrical apparatus. When I moved some ten years ago into a high-class apartment house, it was stipulated that I must make adequate provision not to cause radio interference with my apparatus, and after much consultation, we screened my entire treatment suite of one large and two small rooms. It cost several hundred dollars. I carried out my agreement with the aid of responsible engineers. There still was radio interference. Sparks of the static machine and of the oscillations of both long and short wave diathermy machines would cause signals I could get not only in my own apartment but all through the house. It was not very satisfactory, even though it was very expensive.

Two years ago I moved to a new location and the same stipulation was made. I solved the problem this time, not by screening but eliminating all spark gap apparatus and by adopting the system of contact plate treatment with short wave diathermy. Most of our short wave interference is caused by scattering superfluous energy with air spaced electrodes and, of course, by apparatus the output of which is not properly balanced. Since using contact plates with properly built short wave diathermy apparatus the extra energy interference in space has been eliminated. While my short wave appliances are in action I can turn on and listen to the radio; motor generators in the office and the elevators just outside will still cause some interference. But so far as short wave machines are concerned the use of contact electrodes eliminated interference.

In considering radio interference by short wave apparatus it is not only caused by the widespread use of short wave diathermy by physicians, but also by the general public to whom unscrupulous concerns advertise and sell machines for home use without any medical supervision. It is to be hoped that this part of the interference will be diminished by the enforcement of the new federal laws governing false advertising of certain devices.

Mr. E. K. Jett (closing): Mr. Carter points out that I failed to discuss an important subject, namely the frequencies to be used for medical purposes. Well, I don't think that you gentlemen want the F. C. C. to designate frequencies without first, holding a conference and inviting all interested parties to appear in Washington and give their views, so we have withheld any specific action in the direction of specifying frequencies.

I do feel, however, that frequencies should be specified, and Dr. Coulter has suggested 24, 12 and 8 meters. I hope you will be able to get along with two frequencies, since you do not use them for communication purposes. It would appear that the minimum of frequencies should be assigned.

If it is necessary, from a medical standpoint, to have three frequencies, then, of course, three would be assigned, but it is a very difficult thing for the Commission to find frequencies. We have had considerable trouble in finding them for broadcasters and these various services I mention in my talk, so if you could get along with two frequencies, that would be very well.

Dr. Coulter did recognize that interference does exist. I was gratified to hear him say that. Although he claims that the field strength is only 1/100 of 1 per cent of the field of the radio signal, he is nevertheless admitting that diathermy does interfere with radio reception, so I am glad to know he perceives there is a problem.

What would be 1/100 of 1 per cent. I think you will agree with me when I say that it is a relative thing. It depends entirely on how strong you are able to receive the desired signal and the strength of the diathermy as well. It comes down to the ratio of desired to "undesired" signal. It depends entirely on where the radio transmitter is located and its frequency, and where also the apparatus is located, together with its power, frequency and so on. So there must be times when that field is more than 1/100 of 1 per cent.

He mentioned the cost. I realize, of course, that cost is important to the individual, and in the long run I suppose that cost finds its way back to the patient. We know that it will require more money to build a good machine, one that will not interfere with radio, than to build the other type, the so-called "haywire" machine, if I may use that expression. I do not mean to imply that those on the market now are haywire machines, because I know that since interference was first experienced in 1935, great improvements have been made from an engineering standpoint. I do not say that all diathermy machines are interfering with radio. In fact, I know that all are not interfering. There are some that interfere. Some interfere only over a very short distance. Others interfere over long distances. Some do not interfere at all.

However, it is my understanding — at least I was advised just this morning — that the cheapest type of x-ray machine would cost almost the same price as the type I am asking you gentlemen to buy for diathermy purposes. If that is true, then I don't consider the cost unreasonable. I know that as far as the crystal control or automatic frequency control feature is concerned, it will cost us more money, but assuming that the price without automatic frequency control is of the order of $400, then with the automatic frequency control I don't believe the selling price should be more than $600 or $700.

Now, there is one thing I didn't want to mention in my main talk, but which I feel I should mention now, and that is in connection with this present defense program of the Government. The whole subject of radio becomes increasingly important. Our Commission is now establishing stations and we are taking on some 500 expert radio engineers and radio operators. We are putting out into service

about 100 fully equipped automobiles, with field measuring equipment, direction-finding apparatus, recording apparatus, and so on; and the purpose, as you know, is to look for subversive and unlicensed radio activities.

I mention this because we are all cooperating in the defense program, and it is important that some attention be given to the possible use that may be made of diathermy equipment for communication purposes. That is merely something to think about. I don't know of any movement on the part of anyone to curtail the use of diathermy apparatus, but you who own such equipment should certainly guard against any possible misuse of the apparatus for communication purposes.

I was interested in Dr. Kovács' statement about the operation of his particular machines at a new location. I would like to know more about that, but will not take the time during the meeting.

I made mention of the fact that the Commission intends to call a conference, and I think really that is the best way to solve the problem in connection with radio interference. I told Mr. Carter this morning that I would be glad to arrange to hold such a conference at your convenience. We would, of course, hold the conference in Washington and invite all interested parties to appear and give us the benefit of their particular views with respect to the design, manufacture and use of diathermy equipment. I therefore hope that I will get some specific recommendations as to a date and perhaps as regards the agenda of the conference, either through Mr. Carter or through this particular Congress, in the near future.

FROSTBITE OF EXTREMITIES *

Clinical and Pathologic Considerations in Its Diagnosis and Treatment

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Exposure to cold, unless prolonged and extreme, does not warrant the diagnosis of frostbite without first making a competent evaluation of contributing factors. It has been observed that many cases of preexisting unrecognized circulatory disease have been unsatisfactorily treated as frostbite. The occurrence of gangrene during the summer months without exposure to cold can not be mistaken, but the same condition observed during a cold winter is frequently accepted and diagnosed as frostbite. Greater knowledge of the pathophysiology of peripheral circulatory diseases will assure more accurate diagnoses, and more successful results from therapeutic measures. The fact that physical therapy is of such great value in the management of frostbite suggests the presentation of this subject.

Physiology of Body Heat

The viability of the tissues of the body and the constancy of the body temperature depend essentially upon the mechanism of heat production (body metabolism), distribution (circulation of an adequate amount of blood), and dissipation (heat loss). Failure of these mechanisms will first affect the extremities and in particular the fingers and toes, the tissues farthest from the source of heat.

Coller and Maddock[1] have shown that greater heat production in the body is usually associated with greater heat dissipation with resulting warming of the extremities. Conversely, as a rule, with low systemic metabolism and less heat produced the tissues first to manifest evidence of conservation of heat are the hands and feet. With excessive loss of heat as a result

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of exposure to cold, the constancy of the body temperature is maintained by reduction of the circulation in the extremities. Fluctuations in heat production, distribution, and dissipation require frequent adjustment to maintain the constancy of the body temperature. The circulation in the extremities is an important part of this heat regulating mechanism.

The factors which contribute to frostbite produce a serious imbalance in the heat regulating mechanism. Either too much heat is dissipated, insufficient heat produced, or inadequate heat is distributed to the extremities.

The deleterious effect of cold is influenced by (1) duration of exposure; (2) intensity of the cold; (3) high wind velocity; (4) presence of local systemic circulatory disease; (5) moisture of the clothing, shoes, or gloves; (6) general debility or alcoholism; and (7) smoking. The amount and severity of tissue damage resulting from exposure will depend upon the extent to which any or all of the factors are present.

Dry cold is better tolerated than moist cool weather. Temperatures of 8 F. or lower are usually necessary for severe frostbite to occur, but in the presence of a strong wind, 14 F. or even higher temperatures may be sufficient.[2] Preexisting peripheral circulatory disease such as Buerger's or arteriosclerosis, or to a less extent systemic diseases, such as cardiac insufficiency and anemia are likely to predispose the extremities to frostbite at temperatures considerably above those which would produce the same changes in normal young individuals. Wearers of wet clothing, shoes or gloves are particularly susceptible to the effect of cold weather. This form of frostbite has been designated as trenchfoot and has been reviewed recently by Greene,[3] the medical officer with the British Himalayan Expedition in 1931, and the Mount Everest Expedition in 1933.

In many instances it has been noticed that the weather was not freezing but was very wet and windy when apparent frostbite occurred, information frequently ignored in making a diagnosis. One patient, a very heavy smoker, developed gangrene of the toes after playing golf on a cool, (above freezing) wet, windy day. Another, had an impending gangrene of the toes and distal half of the foot after working in a factory which was cold and the floor wet. Still another, a tunnel worker, developed gangrene of the toes although he had been careful to protect his feet with heavy rubbers, and the temperature never dropped to freezing.

Pathophysiology of Frostbite

The local effects of certain degrees of cold on the tissues are vasoconstriction and necrosis. The vasoconstriction may be of central origin to prevent excessive loss of body heat, or due to the local action of cold on the peripheral vessels. When both local and central vasoconstriction occur, there is, naturally, added danger of necrosis and gangrene of the tissues. This ischemia is similar to that produced by any other cause; consequently, gangrene from frostbite does not differ from other forms due to ischemia.

Necrosis or gangrene may occur as a direct action of intense and prolonged vasoconstriction or as an actual freezing of the tissues with death of the cells and ice crystal formation. This irreparable damage is due, under ordinary conditions, to the withdrawal of water from the cells to form ice or to concentration of the salts.[4]

Vasoconstriction of the peripheral vessels produces a shunting or short circuiting of the arterial blood directly into the venules through normal arteriovenous anastomoses. These are known as the neuromyo-arterial glomus structures which have been intensively studied histologically by Popoff[5] at the University of Rochester. The results of our biochemical studies of

the oxygen and carbon dioxide of the arterial and venous blood of the extremities,[6-7] support the histologic findings of arteriovenous anastomoses. The vasoconstriction which follows exposure to cold or smoking is accompanied by increased oxygenation of the venous blood[7-8] and a reduction in peripheral temperatures, indicating that the arterial blood is shunted directly into the veins without irrigating the superficial tissues. This shunting process is under both local and central sympathetic control.

Prolonged and intense vasoconstriction, short of producing necrosis and gangrene, is frequently followed by an inflammatory reaction. Although the part is cold and clammy, considerable swelling, pallor, cyanosis or redness and tenderness may persist for months or years. Novocain block of the regional sympathetic nerves produces a rapid restoration of the normal peripheral temperature (fig. 1) and a subsidence of the clammy skin. Marked

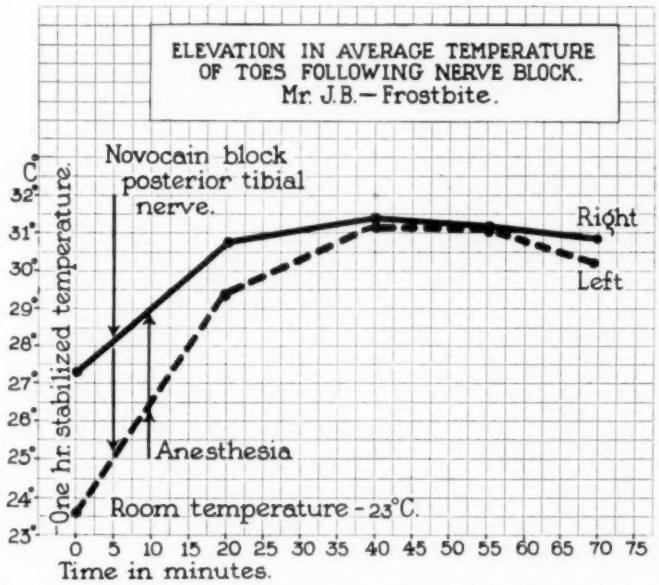

Fig. 1. — Elevation in average temperatures of toes of right and left foot following novocain block of posterior tibial nerve.

clinical improvement frequently follows the procedure. Therefore, the late effect of frostbite is not due to organic changes in the blood vessels but rather to a neuro-circulatory disturbance.

Histologic sections of amputated digits show round cell infiltration surrounding the arteriovenous glomus structures in the skin (fig. 2). These inflammatory changes at the arteriovenous anastomoses seem to account for the clinical and pathophysiologic findings in chronic frostbite.

Differential Diagnosis

The ischemia of frostbite, superimposed upon that of a preexisting circulatory disease, increases the hazard of exposure to cold. Of the peripheral circulatory diseases, more than 90 per cent are due to senile and diabetic arteriosclerosis and thromboangiitis obliterans (Buerger's disease).[9] As a rule adequate information of preexisting disease is obtained from examination of the peripheral arteries by palpation and roentgenograms, from a consideration of the extremities involved, and from the age and sex of the patient. Thromboangiitis obliterans is more frequently overlooked because of

the difficulty in making an early diagnosis in an apparently healthy young man.

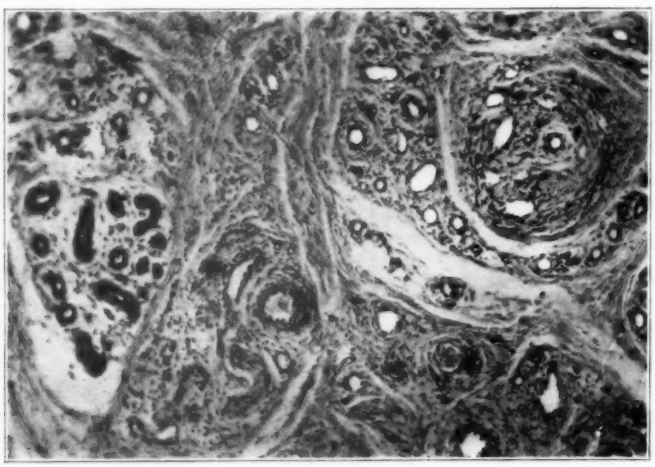

Fig. 2. — High power photomicrograph of section of frostbitten finger showing round cell infiltration surrounding the neuromyoarterial glomus structures. These function as arteriovenous anastomotic units.

Up to this time the diagnosis of this disease has been based upon the age, sex, and race of the patient, the use of tobacco, the absence of peripheral arterial pulsations, and its clinical course. There is increasing evidence that the absence of these findings does not rule out its presence. Obscure conditions can be detected by changes in the blood. This was recently reported in the *Archives of Surgery*.[6-10]

The importance of making a thorough examination for preexisting circulatory disease cannot be overemphasized. Recent advances in this field facilitate a more accurate diagnosis and better evaluation of the type and amount of treatment necessary. The value of obtaining oscillometric and stabilized skin temperature readings, and tests to differentiate organic from spastic disease is evident by the results of treatment obtained in these patients. Many patients in whom the loss of digits or even an entire limb had been anticipated, recovered with little, if any, disability.

A few cases may be briefly cited to emphasize the frequency with which Buerger's disease is overlooked in the diagnosis and unsatisfactory treatment of frostbite. In this group, four stand out prominently. Three patients had repeated local amputations for gangrene due to apparent frostbite, with resulting painful operative wounds which remained unhealed for months. One of these finally died from a cerebral thrombosis. Another refused further amputation for more than six months, when the underlying disease was recognized and appropriate treatment instituted[10] (fig. 3). Although the blood changes which are characteristic of Buerger's disease may be present only during its acute or active stage, examination of the blood should be made in all cases of apparent frostbite especially when the severity of the cold or duration of the exposure are insufficient to account for the extent of the necrosis or gangrene (fig. 4).

Clinical Observations

Frostbite affects the living tissues according to the severity of the exposure and the treatment instituted. The three stages of the disease are:

1. Acute vasomotor ischemia is a result of exposure of the periph-

Fig. 3. — Bilateral thromboangiitis obliterans in adult colored male, originally diagnosed as frostbite. After three years left first toe was amputated; complete relief from pain and rapid healing followed treatment.

Fig. 4. — Thromboangiitis obliterans of left foot of young gentile male. Amputation of the fifth toe of the right (opposite) foot was performed one year previous for what has been diagnosed as frostbite. Recovery followed treatment of the thromboangiitis obliterans.

eral vessels. At the same time peripheral vasoconstriction of central origin acts to protect the body from excessive heat loss. Excessive or prolonged ischemia may be followed by necrosis and gangrene or thrombosis in the arterioles or capillaries. During this stage, injudicious application of external heat may do more harm in hastening necrosis and thrombosis than the damage caused by the exposure to cold.[12] The oxygen supply of the reduced circulation is inadequate for the increase in local tissue metabolism produced by the additional heat. With early and appropriate treatment, and in the absence of thrombosis and extension of the gangrenous process to the deeper tissues, healing occurs with rapid and complete restoration of the skin (fig. 5).

Fig. 5. — Acute vasomotor frostbite of toes. Demarcation and healing of the areas of necrosis occurred within four weeks of intensive treatment; no chronic effect followed.

2. Chronic frostbite may follow the acute vasomotor stage of ischemia. Chilblains, trophic ulcers, and chronic inflammatory changes in the involved extremities with more or less disability may persist for months or years. Rapid amelioration and gradual recovery frequently follow novocain block of the regional sympathetic nerves. Since the regional nerve trunk itself is not affected by the frostbite, these observations indicate that the disturbance is primarily at the neuroarterial junction in the skin where round cell infiltration is found on microscopic sections. The definite clinical improvement and recovery of many cases may be due to the disappearance of the inflammatory reaction.

3. Necrosis and gangrene finally occur as a result of vasoconstrictor ischemia, freezing of the cells, or thrombosis. Thrombosis of the arteries, arterioles or capillaries leads to infarcts in the superficial tissues or to extensive gangrene. The presence of contributing factors will greatly aggravate and increase the amount of cell damage. When cell injury has occurred, therapeutic measures are of little value in preventing necrosis. However, demarcation of the gangrene from the adjacent vasomotor frostbite, which is usually very slow will be hastened and permit earlier amputation. This in turn will benefit also the viable portion of the frostbitten area.

Treatment

Preventive measures include extreme care against exposure to cold weather when there is a high wind velocity, by individuals wearing tight or wet shoes or gloves, or those with circulatory disease, or heavy smokers. Not only should the extremities be protected but also excessive loss of body heat avoided. Adequate body clothing in addition to heavy gloves and shoes, should be recommended. This includes woolen hose and long woolen underwear. The shoes should be large enough to provide room for heavy socks. The skin of extremities with existing vascular disease should be massaged daily with lanolin or a good vegetable oil because the low humidity during the cold winter months produces an unusually dry skin which interferes with good circulation. Surgical asepsis is necessary when blisters or necrosis become apparent.

In the treatment of acute frostbite the application of heat to the affected part is particularly injurious and often leads to rapid mummification of the tissues.[12] The increase in local tissue metabolism as a result of the extra heat requires an increase in oxygen supply which is not available because of the vasomotor ischemia. By slowly elevating the temperature of the exposed part, the increase in circulation will be in advance of the demand for increased oxygen by the tissues. For this reason heat or energetic massage should be used with great caution in all cases of peripheral circulatory disease.

For the gradual elevation of temperature and increase of the circulation, the application of snow or cold water and very gentle rubbing are generally recommended. Novocain block of the regional sympathetic nerves is of definite value in producing vasodilatation in the acute as well as the chronic vasomotor stage (fig. 1). Verbrugghen, at the Cook County Hospital, has had extensive experience in performing periarterial sympathectomy on these patients with good results. It is my belief that satisfactory results are obtained by conservative measures with Pavaex treatments without submitting the patient to the hazard of an operation.

Pavaex treatment with reflex heat has proved of definite value in vasomotor frostbite and for the more rapid demarcation of gangrenous parts. In 1936, we[11] reported the results of Pavaex treatment in peripheral circulatory diseases. Continuation of the study on oxygen and carbon dioxide changes in the venous blood in relation to changes in the peripheral skin temperature have reaffirmed the conclusion made at that time. Alternating positive and negative pressure in conjunction with the action of reflex heat of 45 C. placed on the abdomen, augments local tissue metabolism in addition to increasing the circulation in the extremities. The beneficial effect of this form of treatment is due to increased oxygen and carbon dioxide exchange in the tissues without the deleterious effect of direct heat. Treatment must be adequate and proper to assure satisfactory results.

Local amputation of gangrenous parts should be delayed until definite demarcation has taken place and the circulation has been sufficiently restored in the surviving tissue. This precludes the presence of contributing peripheral circulatory disease. In its presence, local operation frequently leads to extension of the gangrenous process or to failure of the operative wound to heal. Consideration of the factors involved in frostbite will avoid many unnecessary operations and a great deal of suffering.

Conclusions

The serious effect of exposure to cold weather in producing frostbite is proportional to the extent to which contributing factors are present.

Arteriosclerosis, either senile or diabetic, and thromboangiitis obliterans are frequently overlooked in making a diagnosis of frostbite.

Thromboangiitis obliterans offers greater difficulties in differentiation from frostbite and therefore is not usually recognized until failure to obtain improvement or recovery.

The pathophysiology of frostbite is primarily cutaneous vasoconstriction which results in a shunting or short circuiting of the arterial blood directly into the veins. Consequently, the superficial tissues are not irrigated with blood.

Conservative treatment is of great value in the recovery of these patients, and shortens convalescence. When tissue injury has occurred, such treatment will produce more rapid demarcation of gangrene and thus permit earlier amputation.

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RHEUMATOID ARTHRITIS *

Etiology and Treatment

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There is no recognized specific cause for rheumatoid arthritis and no specific treatment. Much is known, however, concerning factors contributing to the onset and progress of the disease, and much can be done for the patient in the absence of specific therapy.

It is almost impossible to define rheumatoid arthritis so that it can be positively identified. If the patient is a young woman who is underweight, febrile, and pale, with a symmetrical swelling of the joints and spindling of the fingers, the diagnosis hardly could be any other than rheumatoid arthritis. Every variation of symptoms, age, physical findings, and clinical history may occur to render the diagnostic problem difficult. The rheumatic condition may be active long before the typical clinical picture is apparent. Joint disease of known etiologic factors may mimic true rheumatoid arthritis.

Classification and Diagnosis

Although all classifications of arthritis are unsatisfactory, some grouping of the different types is necessary. In studying a patient with chronic arthritis, the clinician should ask:

1. Is the disease due to trauma?
2. Is the arthritis due to metastatic localization in the joint of some specific type of bacteria, such as the gonococcus?
3. Are the joint manifestations due to some general disease, or to some constitutional abnormality such as gout, hemophilia, tabes dorsalis, or allergy?
4. Is the disease rheumatoid arthritis?
5. Is the disease primary osteo-arthritis?

The answers to these questions usually classify the patient's disease. A corresponding clinical classification is as follows:

I. Chronic arthritis from a specific or a known cause:
   1. Traumatic arthritis from continued injury of the joint.
   2. Specific infective arthritis from the localization of bacteria of a known type in the joint.
   3. Arthritis occurring as a local manifestation of:
      a. A metabolic disturbance such as gout.
      b. A constitutional disease such as hemophilia.
      c. A neuropathic disorder such as syringomyelia.
      d. Serum disease such as intermittent hydrarthrosis.

II. Arthritis from no specific or known cause:
   1. Rheumatoid arthritis,
   2. Osteo-arthritis.

Although a typical case of rheumatoid arthritis requires no special study, the diagnosis often must be made by the exclusion of other types of joint disease. A

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careful investigation usually enables the clinician to identify an arthritis of a known cause. Thus, traumatic arthritis is apt to involve a single joint which is subject to constant and exceptional strain and trauma. The tennis-elbow is a good example. The constant use of a joint in industrial work is also a frequent cause of traumatic arthritis.

Specific infective arthritis is most difficult to differentiate from rheumatoid arthritis. The disease usually is acute or subacute at the onset, and may become chronic. A careful examination may reveal some active local infection from bacteria such as the gonococcus, streptococcus, or staphylococcus. The larger joints are commonly involved. A striking characteristic of this septic arthritis is the rapid destruction of the cartilage. Bacteria are actually in the joint, and fortunately, the disease usually responds specifically to the newer chemotherapeutic agents.

Constitutional types of joint disease are easily recognized. Gout occurs almost exclusively in men, especially in obese, plethoric, sedentary individuals. At the onset, the attacks generally are acute, very painful, and usually begin at night. The attacks occur at intervals at first, and between seizures the joint returns to normal. In time, the cartilage of the joint involved is destroyed to varying degrees, and the clinical picture becomes one of a chronic arthritis which may be mistaken for rheumatoid arthritis. A careful history and examination should uncover a neuropathic disorder such as tabes dorsalis or syringomyelia. Here a single joint or the joints of a single extremity usually are involved. Hemophilia almost always is characterized by hemorrhage into the joint which, in time, produces permanent injury to the cartilage. The importance of allergy in chronic disease in the joints is not easy to estimate. The constant occurrence of swelling and pain in many joints in serum disease emphasizes the possible role of hyper-reactivity. Many patients with rheumatoid arthritis are definitely allergic individuals.

Early or atypical cases of osteo-arthritis also may be difficult to differentiate from rheumatoid arthritis. The relative benignness of osteo-arthritis, the greater frequency in older, overweight, and relatively healthy individuals, the absence of infection, and the primary involvement of cartilage as a rule differentiate it from rheumatoid arthritis.

Pathologic Characteristics

In rheumatoid arthritis, the characteristic pathologic changes in the joint always should be visualized. The synovial membrane shows a tendency to thickening and proliferation with local collections of small round cells infiltrating the synovial membrane. As the disease progresses, granulation tissue grows over the articular cartilage, often destroying it. Adhesions develop later with an increase in fibrous tissue, limiting joint motion. Bony ankylosis may follow. The initial change is the proliferation of the synovial membrane, so rheumatoid arthritis is designated proliferative arthritis (Nichols and Richardson). As these characteristic changes take place in the synovial membrane, synovial fluid is excessive. The peri-articular tissues swell with considerable thickening of the joint capsule.

Many features of rheumatoid arthritis suggest that it is an infectious disease. Among these are the febrile course, the swelling of the joints with local heat, and the histologic picture of inflammation in the synovial membrane. The occurrence of arthritis with known infection is common. The possibility of some focal infection, especially in the teeth, tonsils and sinuses, has been emphasized for years. From time to time organisms of different types have been recovered from the blood and the joints, but there never have been any consistent results. Most workers now agree that in rheumatoid arthritis, the blood and the joints are sterile, at least by all known methods of culture. It is true that the one most

common event immediately preceding the onset of rheumatoid arthritis is some type of infection, especially with the hemolytic streptococcus. This initial infection is usually acute and disappears entirely, while the joint disease continues to be active and progressive. While an acute infection may initiate arthritis, focal bacterial infection probably has little to do with the continuation of rheumatoid arthritis. It seems equally undecided whether or not focal infection can cause arthritis through bacterial toxemia or bacterial allergy. Many patients with rheumatoid arthritis show skin reactions to various bacteria, especially the streptococcus group. However, patients with rheumatoid arthritis as a rule are hyperreactive individuals who are very susceptible to many bacterial and other toxic products. Many normal individuals may also react to the same toxic products. The presence of agglutinins and precipitins to the hemolytic streptococcus in the blood serum is suggestive evidence for the infectious theory of rheumatoid arthritis. It is an unsettled question whether or not these serologic reactions are a response to streptococcal infection, or are due to some change in the blood serum. Thus, in typhus fever and syphilis entirely non-specific serologic reactions are observed.

It is, of course, possible that rheumatoid arthritis is due to some unknown bacterium, a filtrable virus, or to the specific action of virus and bacterium. Such a relationship is entirely speculative.

While many facts suggest that rheumatoid arthritis is an infectious disease, many others throw doubt on such a relationship. Unquestionable cases of typical rheumatoid arthritis follow events which have nothing to do with infection. Not infrequently arthritis is observed with hyperthyroidism. The patient shows the spindling of the fingers characteristic of rheumatoid arthritis, and the shoulders usually are involved. There is no evidence that infection plays any part in the disease. The hyperthyroidism often is mild but can always be demonstrated. The treatment of the joint disease is dependent upon the relief of the hyperthyroidism. The arthritis will disappear entirely after the thyroid disease is cured.

Similarly, the typical picture of rheumatoid arthritis may develop after coronary thrombosis. Here again there is no evidence of infection and if the patient recovers from the coronary accident, the prognosis is good. It is well known that arthritis often is initiated by exposure to cold and damp. It is now recognized that a nervous shock alone may initiate serious rheumatoid arthritis. Psoriasis, a disease with probably no relation to infection, not infrequently is accompanied by the rheumatoid type of arthritis. The manifestations of both the joint and skin disease usually come and go together. An operation without infection may be the immediate preceding cause.

The mechanism of the production of the joint disease in the conditions cited is unknown. When a patient has coronary thrombosis, there is fever, leukocytosis, and an elevated sedimentation rate in the absence of infection. The changes are essentially in the protein of the blood and perhaps in all body protein. These, at least, cause the variation from normal in the sedimentation rate. It seems possible that some toxic body, perhaps a toxic protein, may arise during this change in the body protein which will cause arthritis.

One might speculate whether in the other, instances mentioned a similar toxic body may not arise. It is certainly true that the agent responsible for the arthritis of serum disease is a toxic protein. Likewise, there may be a similar change in the body as a result of a bacterial infection which can initiate rheumatoid arthritis. Arthritis from scarlet fever persists and progresses although the primary disease and the streptococcus responsible for it disappear entirely.

Etiologic Factors

The fundamental derangement responsible for rheumatoid arthritis may be initiated in a number of ways. Infection is by far the most common exciting

agent, but other events which immediately precede the joint disease may have the same effect as an infection. Since the immediately causative agent, if there is a single one, is unknown, it is most important to determine the influencing and precipitating factors in every patient with rheumatoid arthritis. These may be summarized as follows:

1. Infections.
2. Other disease as hyperthyroidism, coronary thrombosis, and ulcerative colitis.
3. Long continued physical exhaustion.
4. Nervous tension and mental shock.
5. Exposure to cold and damp.
6. Heredity (body build?, allergic constitution).
7. Deficient or improperly balanced diet.

Certain other characteristic findings may belong in the category of influencing factors since they occur so regularly. These are anemia, achlorhydria, and disturbed carbohydrate metabolism.

Management

The first and most important procedure in the management of rheumatoid arthritis is a thorough history, a complete physical examination, and a detailed laboratory study. Only in this way will the important factors be uncovered. A history of previous infections, long continued nervous tension and mental stress, or nervous and physical exhaustion, a family history of predisposition to joint disease and exposure to cold and damp are obtained from the history of the patient. The physical examination reveals undernutrition, concurrent disease such as hyperthyroidism, the physical make-up such as a tall ptotic build, often suggestive of a disturbed sympathetic system, evidence of nutritional deficiency disease, chronic infections, poor posture and poor lung aëration. All of these may influence the development of rheumatoid arthritis. The special examinations should include:

1. A roentgenogram of a typical joint and of the teeth and sinuses.
2. The sedimentation rate.
3. A test meal.
4. Careful examination of the blood for anemia.
5. The basal metabolic rate.
6. Blood uric acid.
7. Glucose tolerance curve.
8. Sometimes roentgenographic study of the gastrointestinal tract.

In our experience, the most important findings in such examinations are the uniformly high sedimentation rate, the diabetic type of glucose tolerance curve in a high percentage of patients, the great frequency of achlorhydria, and anemia and the relative infrequency of any demonstrable focal or other infection.

Since there is no specific cause and no specific treatment, therapy must be directed toward improving the general state of the patient and correcting all abnormalities found. The treatment must be individualized. Many different procedures are utilized in various clinics, so I can only summarize the general principles we have employed in the Cleveland Clinic. The more important ones are:

Rest. — This is the most important element in treatment. One should no more think of ideally treating rheumatoid arthritis without rest in bed than one would active tuberculosis. Often this is impossible. The next best thing is to regulate activity to provide for as much rest as possible. One is constantly impressed with the finding that the patient is in a state of chronic exhaustion

which is markedly influenced by proper rest. Most individuals with any type of chronic arthritis have the idea, usually obtained from a physician, that continuous activity is necessary to prevent stiffening of the joints. While the patient has body-rest in bed, he should have joint-use to prevent stiffening and contracture by carrying each joint through a complete range of motion one or more times each day.

Diet. — There is no specific diet for rheumatoid arthritis. The glucose tolerance curve frequently shows a disturbance in carbohydrate utilization and carbohydrates have often been taken in excess. The diet frequently has been defective in protective foods and proteins. Often patients are underweight, caused more by ravages of the disease than by a deficient caloric intake. The best diet is a low carbohydrate-high vitamin diet with abundant protein and adequate calories. By limitation of sweets and starches, the patient necessarily gets abundant protective foods and protein if the caloric intake is sufficiently high. It is remarkable how undernourished patients will gain weight on a low carbohydrate-high vitamin diet. This diet has to be utilized with clinical judgment in each individual case.

Added Vitamins. — Many patients show evidence of nutritional deficiency disease. This lack certainly is not the cause of the disease but may be an important influencing factor. No harm and often good is done by supplementing the diet with vitamins and mineral elements. Wheat germ and yeast are excellent and may be supplied as such or in a more concentrated form such as vegex. Cod liver oil given in ounce doses twice a day is most valuable. If this cannot be taken, some substitute should be given.

Treatment of Anemia. — Almost every patient with active rheumatoid arthritis has some degree of anemia, usually a hypochromic anemia from an iron deficiency. The anemia often is marked. It may be caused by poor absorption or deficient utilization of iron. If the fault is in utilization, giving more iron is of no value. This can be determined only by therapeutic trial, so we usually give iron in the ferrous form and in adequate dosage.

Transfusion is of the greatest value, both from a general standpoint and to combat the anemia. If possible, it is advisable to give two or more transfusions at weekly intervals. Transfusion seems to do more than simply aid in relieving the anemia.

Removal of Focal Infection. — It seems more and more evident to critical observers that focal infection is concerned only as an influencing factor in rheumatoid arthritis and is not the point at which a specific organism causing the arthritis is harbored. If the infection does get in through the throat, it seems to do so after removal of the tonsils as well as before. It is possible that focal infection is more important early in the course of the disease than it is later. On general principles, any evident focal infection should not be allowed to remain. It is very unwise, however, to remove teeth which are simply suspicious as this so often leaves the patient without adequate masticating surface to insure proper nutrition. The main problem is to decide when sources of infection should be removed. This should be done early in mild cases. The patient with severe chronic arthritis should be on the upgrade if possible before foci are treated. Most of the patients one sees in a clinic already have had every demonstrable focus removed before they present themselves for study and treatment, so little consideration has to be given to focal infection.

Drug Therapy. — The value of drugs in rheumatoid arthritis other than to relieve pain may be questioned. I believe arsenic is most valuable and I use it routinely in all cases. I prefer it in the form of neoarsphenamine, given in doses of 0.3 to 0.4 Gm. twice a week for six to ten injections. Iodine, given preferably as the tincture, often seems to help. This may be combined with Fowler's solution. If the basal metabolic rate is low, thyroid extract should be tried. Since

achlorhydria or hypochlorhydria often may be present, dilute hydrochloric acid should be given also unless a normal acidity has been demonstrated.

The number of other drugs suggested for the treatment of arthritis is legion. I have had little personal experience with sulphur, but, from the observation of results in patients treated by others, I have seen no evidence of its value. Recently gold salts have been used but these often cause toxic effects such as dermatitis or nephritis. Gold is promising, however, and is being used more often. Many believe it should be used only for the seriously ill patients who respond to no other therapy, and in whom the disease is progressing. Time only will determine the place of gold salts in the therapy of rheumatoid arthritis.

Specific and Non-Specific Vaccines. — If the view is accepted that the cause of the disease is unknown, it is apparent that there is no "specific" vaccine. A different organism or organisms are contained in each vaccine suggested for the treatment of rheumatoid arthritis. Vaccines should be regarded simply as adjuvants. Many methods of administration have been used. Probably the best procedure is to inject the vaccine intravenously, beginning with a very small dose and gradually increasing the amount in order to desensitize the patient.

Patients often are helped by non-specific vaccines. For this, the stock typhoid-paratyphoid vaccine is excellent. For the first treatment, 25 million bacteria are injected intravenously. Each succeeding injection is given after twenty-four hours of normal temperature. The amount injected is twice the number of bacteria given as the preceding dose. The temperature reaction following the first injection usually lasts longer than forty-eight hours, so seventy-two hours should elapse between the first and second dose. The succeeding reactions are less prolonged so the third and succeeding doses usually can be given at forty-eight hour intervals. If intravenous vaccine therapy is contraindicated, the vaccine may be given in larger doses subcutaneously. Non-specific protein therapy should not be given to seriously ill, or to aged patients. It should be reserved for use as an aid when the patient is improving and on the upgrade. Three to six injections are given.

Artificial Fever Therapy. — This has not been of much value in rheumatoid arthritis in our hands. Hench[1] has summarized the entire national experience on the basis of published reports. Of about 200 patients treated with artificial fever therapy, less than 10 per cent became symptom-free and about 25 to 30 per cent noted some relief. Early relapse is common after fever treatment. This method of therapy also should not be employed in seriously ill patients.

Physical therapy has a large place in the treatment of rheumatoid arthritis. It consists of tonic measures such as ultraviolet radiation, measures to improve the general and local circulation, and those to prevent or overcome the deformities incident to the disease. The simplest way to get ultraviolet radiation is by direct exposure to the sun, and this is the treatment of choice when the climate and season permit. It is, of course, of value only when the nude body is exposed to the sun. Various heating devices such as cabinet baths, paraffin baths, diathermy, and radiant heat, especially when combined with massage and manipulation, are of great help. Many simple home-made devices are just as valuable as the expensive apparatus. A home baker can be made with a frame and light bulbs, and a paraffin bath with an inexpensive electric hot plate and a double boiler. In addition to the measures outlined, postural and breathing exercises to improve the thoracic and abdominal muscles are of much value. These can be carried out without apparatus or other expense.

Orthopedic Aid. — Every patient with rheumatoid arthritis should be under orthopedic supervision early in order to prevent contractures. The development of contractures while under medical care is an indictment of the physician and can usually be prevented by splinting and proper management. After the disease has run the acute course, if contractures have developed, much can be done to

straighten knees and other joints by simple procedures. Later if necessary, an operative procedure such as posterior capsulotomy on a knee may enable a patient to walk and change him from a cripple to a useful member of society. Early in rheumatoid arthritis a patient is primarily of medical, and secondarily of orthopedic interest; late in the disease he is primarily orthopedic and secondarily medical. There should be medical and orthopedic cooperation in every case.

Climate. — Patients with rheumatoid arthritis certainly do better in a hot dry climate if they stay in such a place long enough. Climate alone, however, avails little as it is only an aid and not a substitute for other therapy. So often we see a patient sent to the Southwest without supervision and no result attained because climate alone is depended on for improvement. Complete treatment is just as necessary in the Southwest as elsewhere.

Recapitulation

Each patient must have individual treatment based on a careful survey. The treatment may be summarized in general as follows:

1. Adequate rest usually in bed — at the beginning at least.
2. Diet adequate in calories and low in carbohydrates, but furnishing abundant protein and protective nutritional elements.
3. Relief of the anemia, usually by transfusion.
4. Long continued physical therapy designed to improve the general condition as well as help the local process.
5. Judicious use of vaccine especially for the non-specific protein effect.
6. Liberal use of arsenic in all cases. The addition of indicated drugs, as thyroid extract and hydrochloric acid.
7. A hot dry climate, if possible.
8. Vigorous use of all indicated forms of therapy simultaneously.

The last point is most important. Most patients with this serious disease try first one drug, vaccine, or physical procedure and then another without thought of an orderly plan of treatment over a long period. Treatment must always cover months and often years. Little is accomplished by the use of different treatments singly when results are dependent on coordinated measures.

Conclusions

A specific cause for rheumatoid arthritis is not known.

The most frequent precipitating factor is a preceding or coincident infection, especially with the hemolytic streptococcus.

Other precipitating factors having no relation to infection such as hyperthyroidism and coronary thrombosis are well recognized.

The one common change in all cases is an elevated sedimentation rate due to changes in the body protein.

It seems possible that a toxic protein may be the immediate source of the joint inflammation such as is known to occur in the arthritis of serum disease.

Every patient with rheumatoid arthritis should have a careful survey to determine the factors influencing the onset and progress of the disease.

There is no specific treatment.

Elements in the non-specific treatment are reviewed in detail.

The one most important point is the coordination of all methods of treatment.

Reference

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TREATMENT OF HYPERTRICHOSIS BY IMPROVED APPARATUS AND TECHNIC

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NEW YORK

Hypertrichosis is one of the most common and embarrassing of disorders affecting women. Like poverty and bodily deformity it is a crushing burden to be borne throughout life. Yet many of us are scarcely aware of either the extent or the degree to which it affects the state of mind of those afflicted with this abnormality.

Endocrine dysfunction is generally considered the etiologic factor. Treatment with hormones, however, has so far not proved satisfactory. Bleaching, plucking, shaving, pumice stone abrasion, and chemical depilation are extensively employed for palliation. These measures are virtually harmless, but the relief is only partial and temporary.

Depilation

There are several methods of permanent depilation: x-ray, excision of the hair follicle with a rotary knife, diathermic coagulation, and electrolysis. With the exception of the latter these methods of treatment have proved either ineffective or too hazardous. Electrolysis which is about the oldest and least objectionable, has also been the most satisfactory. The results obtained by many physicians do not appear encouraging as regrowth and scarification are much more frequent than desirable. The reason for this is that our standards of training and apparatus fall considerably short of the requirements for the successful performance of this delicate and highly exacting type of work. Inasmuch as medical schools and hospitals, with rare exceptions, do not teach this subject, the average physician knows little or nothing about electrolysis. If, in the course of his practice, he decides to treat cases of hirsutism, he learns whatever he can out of textbooks, which is about as helpful as learning how to swim by a correspondence course. The situation regarding the equipment is not much better. The method generally in use is rather crude and ill adapted for the requirements of depilation.

Proper evaluation of electrolysis cannot be made without considering the anatomic and electrochemical factors involved in this form of depilation. It might not be amiss therefore briefly to review these problems in order to gain a comprehensive understanding of the subject.

Electrolytic Action

In electrochemistry, electrolysis means the decomposition of a chemical compound by the action of the galvanic current. When the two poles of a galvanic circuit are immersed in a chemical solution, dissociation of the ions takes place. The electrically positive ions are attracted to the negative pole and the negative ions to the positive pole (fig. 1-a). When a galvanic current is applied to the tissues of the body, as in the case of removal of superfluous hair, the chemical compounds present react in a similar manner. According to Kovács[1] the NCl molecules in the cells break down and the Na ions, which have a positive charge, are attracted to the negative pole (the electrode) where they lose their charge and react upon the water, forming caustic NaOH and liberating hydrogen. The negatively charged Cl ions

are attracted to the positive pole where they lose their charge and react upon the water, forming caustic HCl and liberating oxygen. The chemical reaction (formation of caustics) is limited to the area immediately surrounding the electrode. However, if the current is maintained for an extended period, or if intensified, the caustic matter accumulates and may penetrate beyond the immediate proximity of the electrode and cause proportionately greater destruction (fig. 1-b).

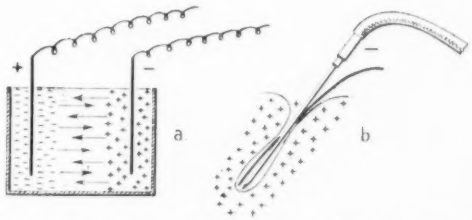

Fig. 1. — Process of Ionization; *A*, chemical solution under action of galvanic current; *B*, electrically positive ions collected around the electrically negative needle.

The epidermis, the hair follicle and the hair bulb are the anatomic structures to be considered insofar as they are concerned in the process of depilation. The epidermis is of interest inasmuch as the hair bulb, which we want to destroy, is located in the deeper strata of this structure and it is known that any appreciable destruction of the skin is likely to result in scar formation. The hair follicle and hair bulb are of interest as the former provides the path which must be followed by the electrode in order to come in contact with the hair bulb. The hair follicle is a tubular body at the bottom of which there is a cluster of cells representing the bulb and responsible for the growth of hair. The mouth of the follicle is a tiny opening on the surface of the skin through which the hair emerges. Hair follicles are usually straight running at a greater or lesser angle in relation to the surface of the skin, but occasionally they are curved or irregular (fig. 2).

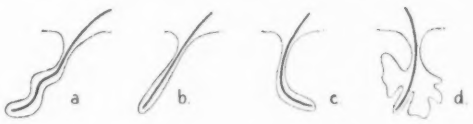

Fig. 2. — Various shapes of hair follicles; *A*, wavy; *B*, regular; *C*, curved, with axis in wrong direction; *D*, follicle forming part of sebaceous gland.

Their depth varies between 1/12 inch and 1/4 inch, but in old individuals who have an atrophied skin, they seem to have no depth at all. The follicles are situated mostly by themselves but sometimes they occupy one of the acini of a sebaceous gland.

Apparatus

While there undoubtedly are certain variations in apparatus, the electrode and holder generally used are substantially the same. The electrode is a plain pointed needle, made of steel or platinum iridium. The holder has the shape of a pencil, is about five inches long, to which the electrode is attached either at a little more than a right angle or in a straight line with the holder. A regular floor lamp is used for illumination. Some physicians also use a magnifying lens.

Successful depilation depends upon the permanent destruction of the bulb without permanent injury of the skin. Permanent destruction of the

bulb in turn depends upon the proper insertion of the electrode into the follicle, in order that the electrode shall come in contact with the bulb and deliver to it an electrical charge sufficient for its destruction. When a pointed needle is used, correct insertion is most difficult and uncertain because the sharp point punctures the skin readily upon contact instead of sliding into the mouth of the follicle (fig. 3-a). But even if it should happen to enter correctly, since the channel of the follicle is narrow and sometimes crooked, the point is likely to plunge through the wall of the follicle, thus missing the hair bulb (fig 3-b). The tendency of the sharp needle to pierce through the tissues is further enhanced by the rigid holder, which causes the needle to go straight forward instead of adapting itself to the course of the follicle. An attempt to probe the follicle with a pointed electrode is like trying to probe a fistula or the lacrymal duct with a needle. It evidently is not the right instrument for the purpose and no one would think of using it. It stands to reason that when a sharp electrode is used correct insertion is a matter of chance. Consequently any time the hair bulb remains intact, or is only partly destroyed, the hair is bound to grow back.

Regrowth of the removed hair is objectionable because it nullifies the work that has been done. Scarification is much more objectionable, however, as instead of correcting, it seriously aggravates the esthetic defect. When the conventional, uninsulated needle is used, scarification is very likely to take place. The area of destruction from this needle includes, in the perpendicular plane, all the tissues between the surface of the skin and the tip of the electrode (fig. 3-c). In the horizontal plane the extent of in-

Fig. 3. — Uninsulated pointed needle with pencil holder; *A*, needle at right angle to holder, piercing the skin outside of follicle; *B*, needle in straight line with holder, piercing wall of follicle; *C*, area destroyed by uninsulated electrode.

jury is commensurate with the exposure and the vulnerability of the skin. Any time the exposure (period of time plus milliamperage) is sufficient to destroy the subsurface structures beyond their normal capacity for repair and regeneration, the superficial skin elements are bound to suffer the same fate. On the other hand, if the current is kept down at the minimum in order to prevent excessive skin injury, there is no assurance of the hair bulb being destroyed. A further disadvantage of the uninsulated needle is that it has to be watched constantly during exposure owing to the narrow margin of safety. This acts as a strain on the operator and slows down the work as one cannot work with more than one needle.

Improved Apparatus and Technic

In order to remedy the shortcomings of the usual equipment and raise the standard of results, I devised certain improvements in apparatus and technic, which were described a few years ago.[2] This opportunity to expatiate on the advantages of these improvements is most gratifying, and it is hoped that this contribution will stimulate wider interest in the problem of hypertrichosis, on the part of the medical profession.

In view of the discussion above, regarding the deficiencies of depilatory equipment generally used, the character of the improvements in the new apparatus to be described will become more or less self-evident.

Blunt Insulated Electrode. — The electrode is made of fine rust-proof wire, 0.004 to 0.006 in diameter and about 6 millimeters in length. This wire is attached to a metal shank of suitable size. A thin coating of enamel covers the entire electrode with the exception of a small portion — from 0.2 to 2 millimeters — at the tip (fig. 4-a, b). The tip itself is rounded and blunt (fig. 4-c). It is the only part of the electrode that communicates current to the tissues.

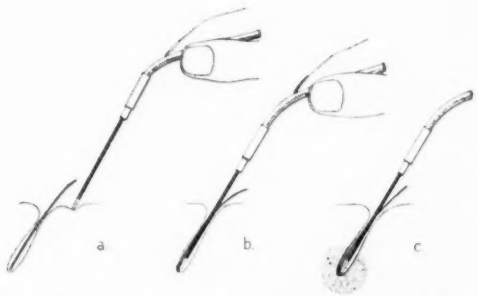

Fig. 4. — Blunt insulated electrode; *A*, gliding along surface of the skin towards mouth of follicle; *B*, electrode within follicle, bare tip contacting hair bulb; *C*, area destroyed by the non-insulated electrode.

Flexible Holder. — The holder presents a marked departure from the conventional handle. As a matter of fact that part is altogether omitted. The chuck, which grips the needle, is made of a small length of open seam tubing the inside diameter of which is the same as the outside diameter of the needle shank, so that it holds the needle by friction. One end of the chuck is attached directly to the conducting cord and the joint between the two is covered with a small non-conducting sleeve. The conducting cord is made of rubber covered tinsel wire and is quite flexible. This conducting cord which acts as holder is firm enough for guiding the electrode, yet flexible enough to buckle if pressure is applied to it.

Multiple Electrode Holder. — This appliance consists of a number of individual holders, joined together and having a common extension line leading to the apparatus. The cords are placed into the interspaces of a spring coil, which in turn is wound through a slot in the horizontal part of a T-shaped fixture. This fixture, with the extension cords in position, is mounted on either a head-band (which is placed on the patient's head) or on a "goose neck" (which is attached to either the machine or treatment table). In order to keep the needles out of the patient's eyes before insertion, the extension cords are folded over and laid across a hooked arm that extends from one side of the holder. Either type holder is adjustable to any desired position and is capable of supporting a considerable number of extension cords.

Magnifying Lamp. — This lamp has an electric bulb and magnifying lens arranged in such manner that the light beam intersects with the focus of the magnifying lens. It thus sharply illuminates a small area while the surrounding area is contrastingly dark. The lamp, being compact and held in the hand, is easily trained on the spot of insertion, bringing it into focus regardless of the plane the area is in.

Technic

The patient lies on the treatment table. The multiple holder is secured in position, directly over the area to be treated, at a distance from the area

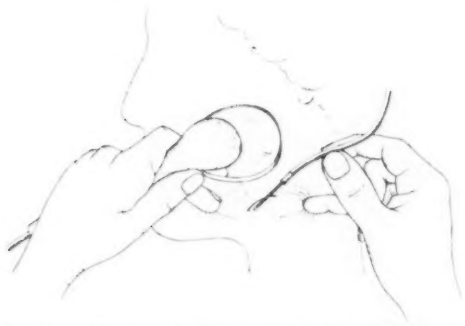

Fig. 5. — Manner of stretching the skin while inserting the electrode with aid of magnifying lamps.

of insertion somewhat less than the length of the extension cords. The several extension cords with the electrodes in the holders are folded over and laid across the hook that extends from the holder in order to keep them out of the way. The skin is now cleansed with alcohol and we are ready to insert the electrodes.

The operator stands on the right of the patient (except when left handed) and inserts the electrodes from the periphery of the face toward the center and from below upward. He commences with the needle on the far side of the holder, then the one next to it and so on. While holding the magnifying lamp in the left hand, he grasps the conducting cord (acting as holder) between the right thumb and index finger (figs. 5, 6). By resting the middle finger of the left hand and the little finger of the right on the skin and stretching it between them in line with the direction of the hair, the follicle is straightened. Approaching the hair from the direction in which it lies, the electrode slips readily into the follicle, finding its way down to the bulb. Providing the operator has a reasonable amount of skill there is every assurance for correct insertion. The magnifying lamp enables him to see the spot of insertion. The bluntness of the tip causes the electrode to slide on the surface of the skin until the tip enters the mouth of the follicle instead of piercing through the skin or the wall of the follicle (fig. 4-a, b, c). The flexibility of the holder allows the electrode to adapt

Fig. 6. — Patient under treatment with 36 needles inserted.

itself to the direction of the follicle instead of forcing it straight through the tissues.

After all the needles have been inserted and their position and direction checked (the holder must be adjusted so as to have all the needles conform to the original direction of the follicle) the current is turned on. Beginning with as little as 1/4 milliampere the current is gradually increased to the required intensity. The exact amount of current and period of exposure necessary can not be accurately predetermined as there are substantial variations between individuals. On the average between two and three milliamperes of current maintained for about three to four minutes are sufficient for 24 electrodes. The elements of time and current are interchangeable to a certain extent. It is safer, and more agreeable to the patient, to increase the time limit rather than the current. In order to determine exposure requirements in a given case it is advisable, first, to make a test treatment and then to apply the amount required for the destruction of the coarsest hair in the group. The test treatment is also necessary in order to find out the average depth of the follicles and use the electrodes (with shorter or longer exposed tips) best suited to the individual case.

When the appartus is equipped with an automatic timing switch the current turns off automatically after the set period of exposure expires. The needles are then extracted in the reverse order of their insertion, each hair being picked off after the needle is removed. Unless the exposure was insufficient, or the electrodes were inserted either too deeply or too superficially, the hairs come out without traction. After termination of the treatment the skin is again washed with alcohol and the patient is instructed to do likewise twice daily during the next few days.

In view of the fact that electrolytic depilation is not regarded with favor on account of the poor results generally obtained, and since the principal departure from the old method consists of confining the destructive process to the subsurface tissues, the more descriptive and rational name *subsurface ionization* is suggested instead of electrolysis.

Summary

The low standard of results from electrolytic depilation is due to: (1) lack of familiarity with the subject of hypertrichosis, since medical schools and hospitals rarely offer opportunity for training and experience; and (2) inadequacy of depilatory equipment as generally used.

An improved apparatus and technic are described which largely eliminate the danger of scarification and regrowth and render the employment of multiple electrodes safe and practical.

Subsurface ionization is suggested instead of electrolysis, as a more rational and descriptive name.

1930 Grand Concourse.

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PHYSICAL THERAPY IN RELATION TO ORTHOPEDICS *

TROY BAGWELL, M.D.

KNOXVILLE, TENNESSEE

In this country there is an ever increasing interest in the care of the cripple — not only in the prevention and correction of his deformities but also in his economic and social rehabilitation. In most communities the orthopedic surgeon is the leader in this work, but he is ably assisted by physical therapeutists and the measures they employ. Orthopedic surgeons realize that they cannot secure the maximum result without the aid of physical agents properly administered at the time.

Physical therapy is more closely associated with orthopedic surgery than any other branch of medicine because the orthopedic surgeon employs physical therapy in almost all his work. There is a vast amount of difference between an immediate surgical end result and the functional end result of any patient who falls into the scope of orthopedic surgery and it is in this gap between surgical end point and final functional end point that physical therapy does its greatest good. Speaking in general terms, the orthopedic surgeon is partial to the following physical therapy measures: rest; traction; temporary immobilization; support; radiant heat; gentle massage; active motion; underwater gymnastics, and diathermy. In the treatment of orthopedic conditions we are confronted not only with surgical management but also the economic factor, which includes the length of time required for recovery, the restriction of activity in this period, and, finally, his residual permanent disability after dismissal.

Broadly considered then, physical therapy in orthopedics is greatest in the restoration of function and in hastening rehabilitation. It would be impossible to discuss all the indications for the physical agents, when to initiate and when to stop them. An attempt will be made to discuss a few orthopedic conditions in order to elicit how closely orthopedics and physical therapy are interwoven.

Physical Therapy in Operative Orthopedics

As has been stated before, there is a great gap between an immediate surgical and the final functional end result in orthopedic surgery. This state of affairs is not usually present in other branches of surgery. For instance, in general abdominal surgery, the surgical end result often is almost coincident with the final functional result.

There is a dearth of literature on orthopedic follow-up procedures. Most articles and books minutely describe the surgical details of a procedure and then blandly remark that physical therapy is a valuable adjunct in the after care, leaving the reader uninformed as to the how and why.

In order to show the relationship of physical therapy to operative orthopedics, let us consider a typical procedure — arthroplasty. This operation involves the reconstruction of the osseous structure as well as all of the component parts of an articulation for the purpose of restoring both motion to the joint and function to the muscles, ligaments, tendons, fascias, and soft structures. The operative procedure is only the first step in reestablishment of function — a carefully planned after treatment to re-educate the atrophic muscles is essential. An esti-

* Read at the Southeastern Sectional Meeting of the American Congress of Physical Therapy, Atlanta, Georgia, May 21, 1940.

mate of the results of arthroplasty should be expressed in terms of function and endurance and not in degrees of motion.

Acute pyogenic infection and trauma are the two causative factors of ankylosis which are amenable to this procedure. The details of the operative aspect do not concern us here. Immediately after operation the limb is immobilized in the most useful position and kept absolutely fixed until the wound has entirely healed. Continuous traction is applied to the weight bearing joints of the lower extremity. After ten to fourteen days, motion is carefully instituted. Passive motion is induced by special apparatus, adapted to the requirements of each joint, under the direct control of the patient. For instance, if the knee is involved, the limb is placed in a hinged Thomas knee splint with a U-shaped bar passing anteriorly to the joint. The splint is locked in the extended position until the wound heals. At the end of that time, a rope is passed from the U-shaped bar of the splint to an overhead frame. A second rope is fastened to the lower cross-bar of the Thomas splint and passed through a series of pulleys to the head of the bed. By adjusting these two ropes, any desired angle may be maintained and active and passive motion may be instituted by gravity, under the direct control of the patient. At first, fear of pain on motion reflexly inhibits voluntary contractions of the muscles.

Only feeble voluntary contractions may be possible, but this is gradually cultivated until the joint can be moved. Motion must be cultivated but not forced. Heat and massage should be employed daily. The cultivation of the musculature, weakened from disuse, must be continued long after a satisfactory range of voluntary motion has been secured. Motion must not be cultivated too rapidly. The best results are obtained when passive and active motions are developed at the same time. If passive motion proceeds too quickly for active motion, the atrophic bone may be softened and the weak ligaments elongated with an increase in laxity of the joint and decrease in muscular control. Unless the musculature can be developed, passive motion in the joint will be greater than active motion, resulting in instability and weakness. Any evidence of inflammation or trauma requires immediate rest until all active symptoms subside. Any decrease in muscular power without inflammation is a danger sign and usually indicates bone atrophy, stretching, or elongation of ligaments with increased laxity. If the joint is stable at the end of six weeks, the splint is removed and walking is allowed in a brace with an adjustable joint at the knee to permit gradual increase of motion. Full weight bearing should not be allowed until the structure of the bone is virtually normal and a fair degree of power has been developed in the muscles.

This follow-up care was described in some detail and for continuity of thought had to be carried through to the end, but when we stop and reflect on what has been said, the relation of physical therapy to orthopedics is strongly evident by the following physical measures: (1) Temporary splint for immobilization; (2) traction to maintain joint space; (3) active and passive motion; (4) heat; (5) massage, and (6) bracing. Such a patient is kept under observation for one year. The surgical procedure required approximately 1½ hours and the physical measures one year! All orthopedic operations do not require so much time or such a wide application of physical agents, but successful surgery from a standpoint of functional end result largely depends upon physical therapy.

Physical Therapy in Non-operative Orthopedics

In non-operative orthopedics physical therapy is often used as a curative agent as well as an adjunct to other forms of treatment. The broad purpose of physical therapy in non-operative conditions is to promote absorption; relax muscle spasm; establish better circulatory conditions, and build up the flexibility and contour of muscles.

To again bring out the close relationship of physical therapy to orthopedics, I would like to mention some conditions so treated by and the types of agents used. Arthritis, peri-arthritis, bursitis, fractures and dislocations, ruptures of muscles and tendons, ischemic contractures, paralysis and the like require among other measures, rest; radiant heat; massage; passive and active motion; manipulations; plaster casts; braces, and diathermy. Here again it would be impossible to give any detailed discussion, and therefore I have elected to take up physical therapy in anterior poliomyelitis.

Poliomyelitis. — Physical therapy finds its greatest usefulness in the convalescent stage. The muscle tenderness has subsided and some return of function begins and the muscles make their greatest gain in power. Treatment aims at preventing fatigue and deformities, which should be undertaken in the second stage when the paralysis first becomes apparent.

Muscle recovery is aided by daily massage to improve nutrition, and careful muscle training to strengthen those most weakened. If there is an associated vasomotor disturbance, heat should be employed before massage. Stimulation by electricity is definitely contraindicated. If splints were applied previously, they should now be removed twice daily and all joints carried through as wide a range of motion as is possible without pain by overstretching an involved muscle or muscle group.

In the fourth or chronic state, when all return of power has ceased, apparatus in the form of braces now comes into use to enhance or allow locomotion, or to prevent or correct deformity. The application of some form of heat is necessary to improve the circulation to the affected parts — dry heat is sufficient. Massage serves to further increase the blood supply, maintain the state of metabolism, and as a form of passive exercise which tends to prevent adhesions in the muscles.

Cerebral Spastic Paralysis. — There are three types of spastic paralysis: (1) the congenital form in children; (2) the acquired form in children, and (3) the acquired form in adults. The affection consists of hemorrhage or thrombosis involving the gray matter of the cerebral cortex.

The dominating factors of conservative treatment are to render the muscles flexible and relaxed by stretching and kneading, and then to teach the patient to use the muscles in the proper manner. Success can only be attained by constant effort and inexhaustible patience on the part of the attendant. If the spasticity is too great to respond to these measures, then surgery must be considered. As there is not, in the exact sense of the word, a paralysis of any of the muscles, no form of electrical stimulation should ever be used, and the same applies to alternations of heat and cold.

Rheumatoid Processes

Arthritis. — The orthopedic consideration in the management of arthritis consists mainly in providing rest, preventing deformity, and restoring function to the joints involved, but the care eventually resolves itself into aid to the patient from many different viewpoints. Here again the orthopedist must largely depend upon physical measures as curative agents.

There are two great classes of chronic, non-specific arthritis: (1) Atrophic or rheumatoid arthritis; and (2) hypertrophic or osteoarthritis. In dealing with atrophic arthritis we must not overlook the fact that it is a systemic malady and must be treated as such. Taking advantage of the old principle, i.e., putting the affected part to rest, cannot be too strongly emphasized. There seems to be an unwarranted fear of ordering a patient with atrophic arthritis to bed, and it is often difficult to obtain the cooperation of the patient because of the fixed opinion in the minds of lay people that these patients should be kept moving.

Rest should be the most important part of the regimen of rheumatoid arthritis — both mental and physical.

The field in which the application of external heat, both systemic and local, has its most extensive and varied application is in arthritis. The full benefits to be derived from the systemic use of heat are not always forthcoming from the heat alone, and sometimes depend on contrasting and accessory application of cold.

Chronic hypertrophic arthritis is a degenerative rather than an inflammatory disease. It is definitely related to trauma and to the stress and strain resulting from faulty body mechanics. It is a disease of the later decades of life. The application of heat here finds its greatest field. The effects are due to a heightened circulation and to the increase of metabolism. At the conclusion of the "bake" or hot bath, a contrast application of cold water acts as a "metabolic whip." The application of local heat and massage should be used in conjunction.

Fibrositis. — Under this group we include a variety of conditions known to the layman under such terms as muscular rheumatism, lumbago, and sciatica. It is essentially a low grade inflammatory condition involving the muscles and fasciae rather than the joints. Here again, the orthopedist must wholly rely upon physical curative agents. Heat, massage, attention to body mechanics and elimination of foci of infection are usually adequate to effect a cure. All local measures are directed at the resorption of exudates and scar tissue.

Bursitis. — There are two anatomic types of bursae: (1) the so-called vaginal bursa which are sheaths about the tendons, and (2) "bursae mucosae" which are the shock absorbers overlying the bony prominences.

These are further subdivided into: (1) superficial and subcutaneous bursae, and (2) the subfacial, submusclar, subtendinous, and periarticular.

Because of their complicated arrangement and the contiguity of important structures, all types of pathologic bursae except purulent infection, should be given the benefit of thorough and prolonged physical therapy before surgery is contemplated.

Trauma and infection are the exciting causes of bursitis, and the process follows the usual course of exudation and the like, to resorption or calcification of the exudative material. The bursae about the shoulder joint give rise to the most disabling condition as they limit motion of the joint with subsequent, rapid contracture of the adductor muscles. The treatment consists of immobilization on an abduction splint and intensive deep heat, preferably by diathermy. This usually suffices for the local process, but a careful search must be made for any distant foci of infection and all possible etiologic factors must be removed.

Treatment of superficial bursitis consists of aspiration of the bursa, with heat, either hydrotherapy or diathermy, and rest of the part often by tight strapping directly applied over the bursa.

Conclusions

An attempt has been made to show the close relationship between physical therapy and orthopedics, by describing some of its uses in certain orthopedic conditions. The two fields are more closely related than any others in medical practice because a large part of orthopedics is physical therapy or utilizes it as the most important adjunct.

The importance of physical therapy in facilitating a good surgical or functional result is strongly emphasized, and it was pointed out that its greatest use is to restore function and hasten rehabilitation as well as reduce terminal disability.

A few orthopedic conditions have been discussed to exemplify the wide application of physical curative and adjunctive measures.

ELECTRODE POSITION IN DIATHERMY TREATMENT

B. D. JUDOVICH, M.D.

and

J. POMERANTZ, M.D.

PHILADELPHIA

The correct application of electrodes in diathermy is of utmost importance. The greatest single factor in the determination of electrode position is clinical interpretation of pain. Many cases of pain in the chest, back and abdomen are due to intercostal neuralgia. It is becoming increasingly apparent, that just as neuralgias may occur in the arms, shoulders and legs, so may they be just as common in other nerves that supply the chest and abdominal wall. For example, low abdominal pain may have its origin in the dorso-lumbar spine, so that in the involvement of the lower dorsal nerves, pain and tenderness are reflected to the lower quadrants of the abdomen. Occasionally patients are subjected to the removal of the appendix or some other organ, and continue to have the same clinical symptoms. Diathermy in these cases should be applied to the dorso-lumbar spine. The application to the site of pain in the abdomen is of little use, and often aggravates the pain by stimulating the periphery of painful nerves.

In a like manner, irritation of the mid-dorsal nerves in the region of the 7th, 8th, and 9th may simulate gall bladder pain, or the upper dorsal roots when irritated and painful may be the cause of precordial pain and simulate coronary disease; so that clinically, intercostal neuralgia may resemble any form of visceral pain.

This interpretation holds true for any of the intercostal nerves. Intercostal neuralgia, or parietal pain, is much more common than has been supposed. It is responsible for at least half of the cases of pain in the chest and pain in the abdomen. One should carefully examine the level at which pain and tenderness occur and look for corresponding paravertebral root tenderness. This site is the correct one for the application of diathermy. It is almost needless to mention that interpretation of symptoms must be guided by complete clinical and laboratory studies. It is important to remember that in neuralgia the point of pain may be anywhere along the course of the nerve, either distally, proximally, or at any part between. The application should be made at the most proximal portion, i. e., paravertebrally. The difference in therapeutic response is marked. It may vary from aggravation of symptoms through erroneous application of the electrodes, to complete relief by their correct application.

In sciatica, the method of applying an electrode along the course of the nerve is not sound, because if we consider the etiologic factors, nearly all forms of sciatica are secondary and due to some mechanical, inflammatory or postural condition, or other process in the lumbar spine and sacrum, a primary neuralgia or neuritis of the sciatic nerve in itself being rather uncommon. Over a period of several years we have observed that localizing the treatment to the lumbar spine and sacrum will give better clinical results than applications along the course of the nerve, or a combined application consisting of one electrode over the lumbar spine and one along the course of the sciatic nerve. In pain referred down the front of the leg and thigh, treatment should be localized higher up in the region of the 2nd, 3rd, and 4th lumbar vertebrae.

(Concluded on page 694)

ARCHIVES of PHYSICAL THERAPY
OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

.·. EDITORIALS .·.

TRENDS IN PHYSICAL MEDICINE CAUSED BY WAR

The history of medicine and particularly of physical therapy reveals apparently paradoxical trends. There were periods when the profession was swayed by ultraconservatism and others during which new measures received almost universal adoption at the expense of older and tried procedures.

The most striking example is found in the external application of heat. This age-old remedy has been almost completely revolutionized by the introduction of short wave diathermy. Its sound physiologic basis and well-known characteristics are responsible for the fact that today it dominates the field of thermotherapy. This is evidenced by its general employment by physical therapeutists and the extensive literature found in scientific periodicals, to say nothing of the large number of monographs. The value of short wave diathermy is so well recognized that many wonder how they managed to practice medicine before its introduction and wonder even more what they would and could do if they were deprived of the use of this agent.

In America at least, such a possibility is not easily visualized, except perhaps in the sense that some new and better discovery might become available in the future. The present agitation with regard to radio interference did arouse some misgivings about the future use of high frequency currents, but only to the extent that the problem can and will be solved by some compromise. But it cannot be ignored that in England the medical profession has been deprived of the use of diathermy and probably will be so deprived for the duration of the present war. That this measure was taken by the British government as a precaution against "fifth column" activities does not help matters so far as the loyal and patriotic physicians and their patients are concerned. The same situation undoubtedly prevails in most if not all of the present belligerent nations. That this protective measure against secret communication with enemies is within the prerogative of the military and civil authorities of any nation engaged in war cannot be denied. That it has already worked hardships is shown by a British colleague whose communication to the Editor of the *British Medical Journal* is published elsewhere in this issue* and indicates that its employment is sharply limited to hospitals or similar places under proper control.

War always had and undoubtedly always will have a definite interrelation with medicine. The Trojan War gave Homer the impetus to sing in verse the virtues of massage. The Persian War proved the incentive to utilize heliotherapy in the management of wounds. Ambroise Paré was forced by the circumstance of war to abolish the cauterization of gunshot wounds by boiling oil and to reintroduce the forgotten method of ligating severed blood vessels. The World War saw the dawn of diathermy and revealed the potentialities of physical therapy as a specialistic discipline. Paradoxically the present struggle in Europe has temporarily at least limited countless sufferers of the great benefits of short wave diathermy.

* Bannen, I. E.: Restrictions on Physiotherapy Apparatus in Great Britain, Brit. Med. J. (Oct. 26) 1940. See page 692 this issue.

Under the circumstances it is not only timely but of decided scientific interest to investigate what if anything can be done to replace short wave diathermy by a measure which cannot be objected to either by the necessities forced upon us by a war of magnitude or by *possible* though not probable developments in time of peace. Not that we lack other methods of applying heat, but these afford only a small fraction of the effectiveness of short wave diathermy and therefore are almost valueless even as makeshifts in certain inflammatory processes, in a large number of painful conditions and in certain types of infections, to say nothing of the usefulness of the high frequency current for surgical purposes.

Perhaps a solution for an eventuality may be found in the very opposite direction of thermotherapy, namely, cryotherapy. Cold in the form of ice-packs has been used a long period in the past for the amelioration of deep inflammatory processes. To this very day a number of surgeons make use of it in acute appendictis when for some reason or other appendectomy cannot be performed. One need only recall that the ice-bags were not applied directly to the skin but over the medium of a piece of flannel, and even then the application was not permitted to exceed one hour and removed only after an hour's interval. It was recognized that prolonged application of intense cold produced at first a reactive hyperemia and later necrosis of the superficial and even subcutaneous tissues. If we substitute for the term "necrosis" the word "burn" by intense heat, we can see a pronounced similarity between the therapeutic effects of heat and those of cold.

The purely surgical use of cold in the form of carbon dioxide snow is another example of a method that had been in vogue for a long time until it was replaced by electrosurgical procedures. Recently some writers have reported its resumption for the management of superficial lesions. The work of Fay and coworkers concerning the amelioration in inoperable cancer by refrigeration of the human body has attracted considerable attention, but is still in the experimental stage.

The most important problem awaiting solution is to be sought in hypothermy for the relief, if not control, of painful inflammatory processes. The experimental research by Bierman and Friedlander[1] presented at the last session of the American Congress of Physical Therapy has established the fact that conductive cooling has a profound effect on certain deeply situated inflammatory processes. This contribution, while requiring further study and development, offers potentialities of decided value.

It is not beyond the realm of possibility that the not distant future may see a new trend in physical medicine which in the main will be a return to old but greatly improved therapeutic measures. This by no means is to be interpreted as favoring the abandonment of such a valuable measure as short wave diathermy. Even granting that it is not devoid of certain drawbacks, these are too insignificant to detract one iota from its merits. But we must not overlook realities, such as are bound to arise if in the course of international events our country should be unable to escape the ordeal of war. But certain conditions in times of peace may prevent many practitioners from availing themselves of the benefits to be derived from short wave diathermy. It is for them and for their clientele that any effort to find a similar though not equally effective therapy must be accepted as a step in the right direction.

Reference

1. Bierman, William, and Friedlander, Mae: The Penetrative Effect of Cold, Arch. Phys. Therap. **21**:585 (Oct.) 1940.

SCIENCE, NEWS, COMMENTS

Knapp Offers Special Course for Technicians

Indirectly news has been received that Dr. Miland E. Knapp of the Medical Section of the University of Minnesota at Minneapolis, is opening his department in the summer of 1941 to technicians seeking a special course in physical therapy. Thus the University of Minnesota will be the only institution teaching physical therapy to nurses in both its graduate and undergraduate divisions. With Knapp at Minneapolis and Krusen at Rochester, it is reasonable to predict that instruction will always match the most advanced and practical in any part of our country.

Edwin N. Kime Promoted Head Anatomy Department of Indiana University

The reputation and contributions of Dr. Kime are familiar to most students of physical therapy. Briefly, his work in electrosurgery is today regarded as among the foremost of opinions on the subject. As head of the Department of Physical Therapy of the Medical Center of the University of Indiana at Indianapolis, his clinical instruction has been viril, progressive and stimulating. With this as a background it is not surprising that his talents and assiduous labors have been recognized by the University in which he has long served, and selected him Chairman and Head of the Department of Anatomy at both Bloomington and Indianapolis. Professor Edwin N. Kime is really not new to his job, for he has been in charge of postgraduate teaching in anatomy these past five years. But be is noted that despite additional honors and obligations, he will continue to be in charge of and lecture in physical medicine and electrosurgery. It is said (*Indiana Daily Student*) that Professor Kime (Ed to you) is a natural pragmatist in habit, for it is recorded that he has stopped smoking 1,000 times . . . and started again 999 times. Perhaps our professor (Doc) hasn't made up his mind whether 'tis better to smoke now than hereafter. A bouquet of congratulations to you from your many well wishing friends.

Wyman In-Charge of Physical Therapy at Marquette University

Dr. E. J. Wyman is to be felicitated on his new opportunities as well as honor in his appointment as Head of the Department of Physical Therapy in the Medical Division of Marquette University at Milwaukee. Dr. Wyman is now offering a clinical course in physical therapy to the entire senior class. If added responsibilities call for congratulations, our friend and member has them in abundance from every part of our country. Success and cheerio.

Formation of New Jersey Society of Physical Therapy Physicians

Announcement is made of the formation of the New Jersey Society of Physical Therapy Physicians, at the Academy of Medicine of Northern New Jersey. Officers elected for the ensuing year were Drs. Jerome H. Samuel, of Newark, as President; Eugene G. Charbonneau of East Orange, as Vice-President; Michael J. O'Connor, of Newark, as Treasurer; and Robert F. Dow, of Paterson, as Secretary.

Dr. B. S. Troedsson, of Orange, was appointed Chairman of the Program Committee, assisted by Drs. Richard Coe and Eugene Charbonneau.

It was decided to hold meetings monthly during the winter season in variable centers in the State. The next meeting will take place in January, in Essex County; details will be announced later.

New York Physical Therapy Society Meeting

The New York Physical Therapy Society will hold its regular November meeting, Wednesday, November 6, 1940, at 8:30 P. M., at the Liederkranz Club, 111 East 58th Street, New York City.

The following program is planned:

I. Scientific Session. — Physical Therapy in Foot Disorders. *Jerome Weiss*, M.D. Discussion opened by *Hans J. A. Behrend*, M.D.

II. Executive Session. — Physical Therapy and Preparedness.

This will be a closed meeting for members in good standing only.

Report of Committee on Physical Therapy of the Indiana State Medical Association

The following communication was submitted to the House of Delegates of the Indiana State Medical Association by the Committee on Physical Therapy. It is an example of deliberations that are bound to have a favorable influence on the practice of physical medicine in each locality and should therefore be read with a view of adapting such a program to that of other States. In short, its objective is to teach the scientific practice of physical therapy to the greatest number and to present clinical programs at stated meetings and seminars. The report of the Indiana State Committee on Physical Therapy reads:

The principal objective of our committee was announced at the beginning of the year as follows: "It will become our duty to foster an educational program throughout the year and to try to acquaint as many men as possible with the legitimate practice of physical therapy." To this end several county societies arranged for papers covering this subject, and we have a noted speaker appearing on the state program.

A hospital survey was made by one of our committee and is of sufficient import to be given special attention in the JOURNAL.

Since the Indiana University Medical School is one of the few in the country giving adequate under-graduate instruction in physical medicine, we recommend the inclusion of this field in the annual postgraduate courses. We would further recommend the attention of the Medical School authorities toward the establishment of a school for technicians in connection with the University Hospitals. We would finally recommend the continuation of a committee on physical therapy as one of the standing committees of our state organization.

We sincerely express our appreciation to Tom Hendricks and others throughout the state who have helped with our problems.

Respectfully submitted,

E. L. Libbert, M.D., *Chairman.*
H. W. Smelser, M.D.
E. N. Kime, M.D.
B. L. Harrison, M.D.
N. H. Prentiss, M.D.

Restrictions on Physiotherapy Apparatus in Great Britain

Sir. — My sympathies go to those unfortunates who are for the most part dependent on the income derived from physiotherapeutic treatment, such as diathermy and short wave therapy. One reads in the lay press of a marvelous new "radio" treatment for the common cold employed in factories and apparently available to all and sundry who may care to visit the place. Meanwhile, the medical specialist in this branch who has nursed and developed this form of therapy since its inception in this country stands idly by waiting for his apparatus to be impounded by the Post Office. The Press comments on radio treatment now savour very much of the old ultraviolet lamp, which would bring sunshine and health to all and sundry, the panacea for all ailments.

The whole business of short wave therapy now appears to be passing from the pioneer workers into the doubtful realms of popular medicine. The private patient with acute fibrositis or lumbago is now debarred from access to this treatment unless he goes to a voluntary or other hospital, but if one morning he suffers from a common cold he may, if he is fortunate, receive treatment at the hands of a "pretty masseuse" (*vide* daily press) at the factory. It seems to me that this suppression of a responsible minority is both unjust and unnecessary. The number of skilled workers in this branch is small, and with adequate screening interference with radio communication could be eliminated in one place as well as another. Whatever consultations have taken place before this ban was imposed, it seems to me that insufficient consideration has been given to the very men who have brought this treatment to its present stage of efficiency. — I am, etc.,

Hull, Oct. 16. I. E. Bannen.

Brit. M. J. (Oct. 26) 1940.

Barger to Direct Physical Therapy at Georgetown University Hospital

For the past two years Dr. G. J. P. Barger of Washington, D.C., has held a clinic in physical therapy at the Georgetown University Hospital. Recently he has become officially associated as head of their Department of Physical Therapy, which calls for congratulations and best wishes.

Colchicine Used on Rabbits to Double Chromosomes

The same powerful chemical that has been used in the creation of new and larger fruits and flowers has been tried on rabbit egg cells.

Colchicine, which doubles the number of heredity-bearing chromosomes in plant cells, allowed the production experimentally in glass vessels of rabbit egg cells with double the normal body number of chromosomes. The research is reported by Drs. Gregory Pincus and C. H. Waddington of England's Cambridge University.

Cell division in the experiments did not go beyond the very earliest stages of development. For the present at least, therefore, dreams of colchicine-induced races of giant super-rabbits (and, by inference, of giant super-men) must remain only dreams.

Artificial increase in mammalian chromosome numbers has never been accomplished before, and natural occurrence of higher numbers of these heredity-bearing units in the cell's nucleus has been reported only once or twice, and then not in egg cells but in structures associated with the developing embyro.

Drs. Pincus and Waddington accomplished their results by treating fertilized rabbit egg cells with colchicine, already well known for its chromosome-multiplying effects in plants. They also used alcohol, ether, and abnormally high temperatures; but colchicine was most effective.

The doubling of chromosome numbers resulted from the slowing down of the cell division process. The first stages of division, in which the chromosomes split and thereby double their number, went through as usual, but the cells then failed to finish the process, leaving the two sets of chromosomes in the undivided cells.

Subsequently a few of these cells did divide, but only at a rate less than normal. In no case did such divisions go beyond the very earliest stages.

Dr. Pincus was formerly connected with Harvard and Clark Universities and the present work was aided by grants from the Josiah Macy, Jr., Foundation and The Milton Fund of Harvard University. — *Science News Letter.*

New Serum Will Cure Spotted Fever, Is Hope

Serum that may prove a cure for dangerous Rocky Mountain spotted fever, the tick-borne disease that every summer threatens ranchers in the far West and suburbanites on the Eastern seaboard, has been made by Dr. Norman H. Topping, National Institute of Health of the U. S. Public Health Service.

The serum, so far used only on guinea pigs and monkeys, is "the first definite hope of a specific treatment for Rocky Mountain spotted fever," officials of the National Institute of Health declared.

Guinea pigs and monkeys survived usually fatal doses of spotted fever virus when treated, after

they became sick, with blood serum from rabbits that had been immunized to the virus. Details of the preparation of the serum are reported by Dr. Topping.

Public health officials hope the serum will prove as useful in treating sick humans, but that cannot be determined until more of the serum has been made.

While this serum will, it is hoped, prove useful in treating sick humans, the federal health service has recently announced a new method of making a vaccine to protect against Rocky Mountain spotted fever. Advantage of this new vaccine over the old one is that it can be made on a large scale. The difficulty and danger of making the old vaccine limited the amount that could be made, and thus its usefulness.

Neither the vaccine nor the serum, however, is yet available for general use. Further tests must still be made with them, it was explained. — *Science News Letter.*

"Grapes of Wrath" Migrants Get Help Through Association

Medical help for the acute health problems of the "Grapes of Wrath" migrant agricultural workers in California and Arizona is being given as fast and far as possible by the Agricultural Workers Health and Medical Association, it appears from a report to the American Medical Association by its bureau of medical economics chief, Dr. R. G. Leland.

Nearly 38,000 migrant workers and their families have already been given medical, dental, hospital and other health care by this mutual benefit association, organized in May, 1938. Doctors, dentists, druggists and hospitals of California and Arizona, the Farm Security Administration, the California State Department of Public Health and the U. S. Public Health Service have cooperated in planning and carrying out the program. The Association is empowered to borrow money for paying doctors' and other bills and purchasing supplies, from the Farm Security Agency or other federal or state agencies. For the first year of operation $952,597.97 was spent.

Headquarters of the Association are at Fresno, Calif., with regional offices in Arizona and as far north as Willows, Marysville and Santa Rosa, Calif. The personnel of these regional offices has followed the crops, in the wake of the migrant army, in order to be near at hand to serve it. At first member patients were referred to doctors' and dentists' offices in the vicinity, but now most of them are served in clinics staffed by doctors chosen by the county medical societies.

Influenza, pneumonia and other respiratory diseases and digestive diseases ranked high in numbers of member patients treated. Malnutrition and dietary deficiencies were fairly prominent among children. Babies were delivered, broken bones were set, infections, injuries and dental troubles were cared for. Services are primarily for acute sickness or injury, but when a chronic illness threatens the welfare of the entire family by laying up its breadwinner or the mother, such illness is treated. — *Science News Letter.*

Vitamin E Hailed as Possible Cure for Hopeless Disease

Vitamin E, known as the fertility vitamin from wheat germ, is being hailed in medical circles in London as a probable cure for hitherto hopeless diseases of muscle weakness and nerve degeneration.

It is also seen as a possible means of protecting children against infantile paralysis and adults against one horrible result of syphilitic infection, locomotor ataxia.

Striking results in treating more than a score of human patients suffering from incurable and even fatal muscle weakness and nerve degenerative diseases with vitamin E are reported by Dr. Franklin Bicknell, honorary physician to the Farrington Dispensary in London. (*The Lancet*, Jan. 6.)

The vitamin should also be used to protect children against infantile paralysis, at least during epidemics, Dr. Bicknell declares, though his report does not include such use of the treatment. He believes that in children who have a diet rich in this vitamin the nerve and brain cells attacked by infantile paralysis virus will be more resistant.

Lack of this vitamin in the diet, apparently necessary for nerve and muscle health as well as for normal reproduction, may explain why some patients with syphilis later develop locomotor ataxia while others do not. Arrest of this painful, disabling condition may be possible with the vitamin treatment, Dr. Bicknell believes. He tried it, without success, in two cases, but the condition was too far advanced in these patients for the negative results to show what the vitamin treatment can do.

Locomotor ataxia, he believes, may be the result not of syphilitic infection alone but also of a deficiency of vitamin E causing a degeneration of nerve tracts already weakened by syphilis.

Muscular dystrophy, amyotrophic lateral sclerosis, peroneal muscular atrophy and amyotonia congenita are the muscle and nerve disorders for which Dr. Bicknell used the wheat germ or vitamin E treatment. Results of treatment in the muscle weakness condition were remarkable, every patient except one, even bedridden patients, showing improvement.

These patients, 15 of them children, are apparently the first humans to receive the new vitamin treatment, although the discoverer of the vitamin, Dr. Herbert M. Evans, of the University of California, reported success in vitamin E treatment of similar muscular weakness and wasting in animals.

Vitamin E has been called the fertility vitamin because it is necessary for normal reproduction, but Dr. Bicknell suggests that the substance in wheat germ which produced striking improvement in his patients may be something other than the fertility vitamin. For this reason, suggested by animal studies, he used fresh dried whole wheat germ, one-half ounce twice daily, to treat patients, rather than the chemical, alpha tocopherol, which has been identified as the pure form of the anti-sterility vitamin.

"Our diet may in some cases be on the edge of a vitamin E deficiency," Dr. Bicknell charges, pointing out that the most important food source of this

vitamin, wheat germ, "is to all intents and purposes never eaten" because it is removed from the wheat flour in ordinary milling processes. Other foods containing small amounts of the vitamin may lose it in the course of storage and preparation. — *Science News Letter.*

Relaxation in Essential Hypertension — Jacobson

(*Continued from page 654*)

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9. ibid 4, chap. 5, 6.

10. ibid 7, Chapter 18 in Volume III, "The Technic of Progressive Relaxation," edited by E. Jacobson (rev. ed. in press).

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Electrode Position in Diathermy Treatment — Judovich and Pomerantz

(*Continued from page 688*)

In general, we should interpret exactly what areas are involved in the peripheral distribution and then attempt to localize treatments to the paravertebral region, at which point root tenderness can usually be elicited by deep palpation. The failure to do so with consequent lack of clinical results or aggravation of symptoms, may cause a useful procedure to be condemned as being of questionable value.

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BOOK REVIEWS

ORTHOPEDIC SURGERY FOR NURSES INCLUDING NURSING CARE. By *Philip Lewin*, M.D., F.A.C.S., Associate Professor of Bone and Joint Surgery, Northwestern University Medical School; Attending Orthopedic Surgeon, Cook County and Michael Reese Hospitals; Consulting Orthopedic Surgeon, Municipal Contagious Disease Hospital; Lecturer to Nurses of Cook County School of Nursing and Michael Reese Hospital, Chicago. Third revised edition. Cloth. Pp. 462 with 195 illustrations. Price, $3.50. Philadelphia and London: W. B. Saunders Company, 1940.

The domain of orthopedic surgery has become so extensive that the usual, general training of nurses has proved inadequate for proper care. This book, written by an outstanding surgeon, aims at augmenting such training and achieves its purpose by a text carefully prepared for the class of readers it will reach. What Lewin wants is not only technical mastery of the preoperative and postoperative care of orthopedic patients but the intelligent cooperation of the nurses. For this purpose he discusses all affections commonly referred to as orthopedic in nature, but familiarizes the nurse-student with the material equipment provided in modern hospitals. The present edition while in the main adhering to the organization of the descriptive matter of the preceding issues has been not only revised in order to bring it down to date, but amplified by new chapters. The most important of these perhaps is devoted to orthopedic nursing care, which in 17 pages considers every detail of bed-ridden or crippled patients and teaches the recognition of impending complications. Another new chapter discusses the scope of special orthopedic nursing in hospitals and in public health. A third new chapter deals with the treatment of infantile paralysis.

Physical and occupational therapy are discussed in a special brief chapter in which the various measures are pointed out without any references to their technics. While it is true that these incorporate special procedures often left to be carried out by technicians under the direction of qualified physical therapeutists, it seems that they could have been advantageously discussed at greater detail. Thus the subject of occupational therapy is covered in only two paragraphs, plus a photographic reproduction of a hospital occupational work room utilized by handicapped children. Inadvertently a slight error has crept in. In discussing the sciatic syndrome there is a reference to Bier's hyperemia explained as the use of heat from an alcohol lamp. Apart from the fact that no nurse could guess how to make use of such an appliance, Bier himself resented any description of dry hot air by his name, since heating apparatus had been employed long before him. What he does wish to be known as his hyperemia refers to the application of an elastic compressor to produce passive hyperemia.

On the whole this is a most valuable contribution to the nursing literature which undoubtedly all nursing schools will welcome for reliable guidance. The illustrations are all that could be desired for visual instruction, and the format of the book is in keeping with the importance of the work.

ARTHRITIS AND ALLIED CONDITIONS. By *Bernard I. Comroe*, M.D., F.A.C.P., Instructor in Medicine, University of Pennsylvania; Ward Physician, Hospital of the University of Pennsylvania. Cloth. Pp. 752 with 200 illustrations. Price, $8.50, net. Philadelphia: Lea & Febiger, 1940.

This contribution to the problems and management of arthritis and allied conditions is so comprehensive and authoritative in scope that one is tempted to express one's appreciation in terms that run to the superlative. The work has that erudite quality associated with originality of thought and independent expression as to raise the exposition to the dignity of an unusual contribution. Prepared as a practical aid for physicians in the diagnosis, prognosis and treatment of arthritis and its various manifestations, the author has lucidly presented the answers to a multitude of questions at present discussed with reference to the merits of different procedures, both in the line with use of pharmaceuticals, chemicals, physical agents, and the like. Thus one finds the various chapters replete with information on the value of such new forms of therapy as sulphur, gold, bee venom, chaulmoogra oil, large doses of vitamin D, foreign proteins, vaccines, endocrine preparations, as well as opinions based on the use of combined measures which among other things make use of such procedures as iontophoresis, diathermy, hyperpyrexia, massage, hydrotherapy, and the like. The text, however, is also representative of opinions culled from other authoritative contributions and includes the most detailed survey of a literature so extensive that its designation of encyclopedic is not out of place. As a practical aid to the practitioner, it but needs to be pointed out that among the many topics discussed are certain still debatable problems such as whether pulpless teeth and suspected tonsils should be removed or dealt with otherwise; or whether certain new drugs possess curative or temporary values such as sulfanilamide, sulfapyridine, or sulfathiazol which are being used in increasing amount in the antiarthritic regimen. In the space of forty-six chapters to which are appended generous bibliographies, the author discusses in detail the clinical and laboratory methods and diagnostic facilities used in modern practice in the treatment of this protean problem. It also includes such detailed but minor topics as flat and painful feet, fibrotic involvements and other miscellaneous ailments that are as crippling in their physical and economic aspects as the rheumatoid patient with major complications. Accordingly here is an excellent work that should be

read by every practitioner, for it belongs to the "must" group of our medical literature.

SCIENTIFIC INTESTINAL IRRIGATION AND ADJUVANT THERAPY. By *Joseph E. G. Waddington*, M.D., C.M. (Bennett). Foreword by *W. Kerr Russell*, M.D., B.S., Physician-in-Charge, Physiotherapy Department, National Temperance Hospital, London. Cloth. Pp. 310 with 35 illustrations. Price, $5.00. Chicago: The Bryan Publishers, 1940.

Here is a thought provoking book that will challenge the complacency of the profession because it critically reviews the unsatisfactory interpretation and management of the problem of constipation and of intestinal insufficiency. Whether or not one agrees with or disbelieves in the principles expounded by the author, one is certain to close this book in a reflective mood or one even more responsive toward the possible virtues of the treatment therein advocated. There is an earnest though elusive eloquence to this exposition that can only be attributed to the fact that the author has reflected back into his pages a profound conviction and understanding of the problem. The pages are replete with well chosen references (over 300) from undoubted authorities in their respective fields and with conservative evaluations and clinical observations — all of which have been blended into conclusions that only those who cannot differentiate slogans from facts will remain cold to the obvious truths woven into this thesis. Bespeaking the support of this form of therapy and for its kindly reception, W. Kerr Russell of England, in his foreword, calls attention to the antiquity of colonic irrigation in the healing art and insists that its survival to the present scientific age is undoubtedly due to inherent virtues which unfortunately have been exploited or condemned by the misinformed. Be that as it may, the author is the most recent advocate who appeals to organized medicine for a hearing of the scientific nature of intestinal irrigation. In the space of eighteen chapters he has attempted to elucidate the facts and fallacies, the truths and misapprehensions of colonic lavage therapy in a concise and comprehensive manner. He presents his data in a well organized manner by first outlining the so-called philosophy of intestinal irrigation and then entering into the very meat of the subject by reviewing the anatomic structure and physiologic function of the intestinal canal, and then correlating the problems of digestive dysfunction and its symptoms to the end of presenting the treatment and technics (which include dietetics and exercise) found most practical in his and other contemporary workers in this field. The chapters on dietetics, laxatives and exercise help to clarify the rationale of intestinal irrigation, and their inclusion into this volume suggests the practical value of such therapeutic collaboration for those interested in this practice. Unquestionably this is one of the most readable and understandable contributions on the subject and should go far to increase its standing within the ranks of scientific medicine.

GARDINER'S HANDBOOK OF SKIN DISEASES. Revised by *John Kinnear*, T.D., M.D., M.R.C.P. (Ed.) Lecturer in Diseases of the Skin, St. Andrew's University, Physician for Diseases of the Skin, Dundee Royal Infirmary, etc, etc. Fourth Edition. Cloth. Pp. 239 with 70 illustrations, 16 in color. Price $3.50. Baltimore: The Williams and Wilkins Company, 1939.

Within a period of two decades this handbook on skin diseases from the pen of the late Dr. Gardiner, has passed through four editions, indicating its practical value and popular demand. The present edition has been revised and brought down to date by Kinnear with the aim to provide a handbook in adherance with the work of his predecessor for both students and practitioners who desire compact description of the common rather than rarer skin diseases. Detail has been expended along the more useful types of treatment in order to meet the general demand for a work that is concise and practical. Kinnear has however assumed the responsibility of many new views which differ widely from those held by Dr. Gardiner, and for this deviation the reader will be fully compensated by the benefits accrued therefrom. This departure of opinion will be recognized by his use of the personal pronoun in order to distinguish the views held from those of his late colleague. The text proper is divided into 14 chapters that review the various types of more common dermatoses of an infectious, glandular, toxic and those associated with nerve dysfunction, or associated with lack of vitamins or from some unknown origin. The work also discusses the causes and treatment of hypertrophies and tumors of the skin, both benign and malignant, congenital affections of the skin, such as nacvi, moles and the like, and diseases of the hair. The appendix provides a series of recommended prescriptions of proved value. The rich illustrative material both in color and black and white is an aid to one's diagnostic acumen and brings about a clearer orientation of the many skin affections met with in daily practice. Its pocket size, its lucid descriptive material and terse guidance combine to make this edition a valuable asset to one's library.

INTERNATIONAL ABSTRACTS

Clinical Applications of Electrically Induced Convulsions. W. H. Shepley, and J. S. McGregor.

Proc. Roy. Soc. Med. **33**:267 (March) 1940.

The chief points of electrically induced convulsion therapy as compared with other methods, can be summarized as follows: The electrical method is well tolerated by the patient who is freed from the dread which hitherto was associated with these necessarily continued treatments. The disagreeable sequelae of drug-convulsants are notably absent, such phenomena as vomiting, confusion, and psychomotor restlessness which formerly required close "after-supervision" are not evident. The method is devoid of such former technical complications as thrombosis of veins, a feature of a special importance where insulin is used either subsequently or in combination. The method can readily be combined with other treatments such as insulin, and being a procedure of physical therapy removes all question of toxicity or cumulative action. By virtue of the last-mentioned facts, the procedure is completely controllable, a succession of fits not intended being unknown. It is ideally suitable for the indefinitely prolonged treatment in those not infrequent cases where an occasional convulsion is essential to prevent relapse. The method may well reduce the incidence of fracture since the fits upon the whole appear less strong. In a series of some 200 induced major fits neither fracture nor dislocation has so far occurred. The method readily facilitates repetition without the attendant difficulties of a struggling patient, the abortive fit inducing quiescence and a willingness to submit to further treatment, in marked contrast to cardiazol administration under similar circumstances. To this should be added the advantages of economy, and the need for less nursing attention and supervision.

Fever Therapy at the Ohio Girls Industrial School at Delaware. D. S. Cowles.

Ohio State M. J. **36**:378 (April) 1940.

The conditions treated in this public institution ranged from congenital syphilis, systemic syphilis and optic atrophy to gonorrhea, non-specific salpingitis and rheumatism. The technic of the fever (induction in air-conditioned cabinet) was that in vogue in most hospitals, including adequate preparation before instituting the fever therapy.

The results show remission in all cases of gonorrhea (20) and in 19 out of 24 patients with systemic syphilis. The 19 patients had gone through the prescribed course, while the remainder failed to complete it. A remission was attained also in one patient suffering from congenital syphilis complicated by optic atrophy and juvenile tabes. There were five patients with non-specific salpingitis, with remission obtained in one. Two patients with "rheumatism" appeared to be freed of their temperature.

The fever was administered 6 to 8 hours, with the desired temperature level being maintained 2 to 5 hours, according to indications. In the venereal cases the number of treatments depends on the serologic findings. If a negative reaction is seen after one session, this treatment is no longer continued, but the patient is submitted to tests every three months. During the 1938 period there were no recurrences in 37 venereal girls. Clinical studies also showed that a combination of fever with chemotherapy gives better results, and that the effectiveness is most pronounced when treatment is instituted at an early stage of the disease.

Action of Short Radio Waves on Tissues — A Comparison of Thermal Sensitivities of Transplantable Tumors in Vivo and in Vitro. Herbert J. Johnson.

Am. J. Cancer **38**:533 (April) 1940.

A technic for measuring the temperatures produced in transplantable tumors by means of short radio waves is described, which enables continuous temperature records to be made during treatment. The variation in temperature at different depths in the tumor is minimized by the method.

The thermal sensitivities of the Jensen rat sarcoma and Walker rat carcinoma have been compared over a range of temperatures from 47 to 43.5 C. The exposures required to produce 50 per cent regression of the Walker rat carcinoma at 47, 45, and 43.5 C. are forty-five minutes (approximately) one and a half hours, and six hours, respectively, while those for the Jensen rat sarcoma for the same range of temperature are twenty-five minutes, one hour, and three hours.

It has been shown that the Walker rat carcinoma is more resistant to heat in vivo than the Jensen rat sarcoma. No difference in sensitivity between Walker rat carcinoma and Jensen rat sarcoma can be demonstrated in vitro. The thermal death times for both tumors are approximately 47 C., in less than twenty minutes; 45 C. in one hour, and 43.5 C. in three hours. A 42.5 C. three hours' exposure produced 50 per cent destruction of the tumors, whereas at 41.5 C. no lethal effect was produced by exposures of that duration. It has been shown that both tumors are more resistant to heat in vivo than in vitro.

Irradiation of Carotid Sinus in Hypertension. A. Delachaux, and G. Schneider.

Schweiz. med. Wchnschr. **69**:522 (June 10) 1939.

On the basis of their observations, the authors conclude that the treatment of hypertension by irradiation of the carotid sinus with short waves can be used for ambulatory treatment. They give three treatments a week for a period of from two to three weeks. They obtained improvement in fif-

teen of their thirty-three cases when the usual medicinal methods had failed. The best results were obtained in the patients with arteriosclerosis and essential arterial hypertension. In generalized arteriosclerosis and hypertension, however, the results were less frequent and less clear. Finally, the patients with chronic nephritis reacted only slightly to the irradiation. In essential hypertension and in arteriosclerosis the patients experience a sensation of well-being at the same time that a greater or lesser decrease takes place in their arterial tension, whereas the patients with chronic nephritis and often also those with generalized arteriosclerosis have disagreeable sensations and slight fluctuations in blood pressure. The method is contraindicated in chronic nephritis, asystole and thyroid disturbances. If generalized arteriosclerosis is accompanied by hypertension the short wave treatment of the carotid sinus can be tried, but if the reactions after the first irradiations are disagreeable it should be discontinued. — [J. A. M. A. **113**:726 (Aug. 19) 1939.]

Problem of Rheumatism and Arthritis: Review of American and English Literature for 1938. Philip S. Hench; Walter Bauer; M. Henry Dawson; Francis Hall; W. Paul Holbrook; J. Albert Key, and Currier McEwen.

Ann. Int. Med. **13**:1837 (April) 1940.

The above listed group of authors reviewed the literature of the year 1938 for arthritis as a part of the rheumatic problem. Among the therapeutic assets and deficits included are the benefits and limitations of physical measures for atrophic arthritis. Hydriatic procedures are evaluated even reviewing such unrelated agents as paraffin and mud packs, as well as such established and classic procedures as waters utilizing hyper and subnormal temperatures in both normal and saline baths, fever therapy, and the like.

Paraffin baths (wax at 130 F.) and mud packs (at 110 to 125 F.) can be given at high temperature because of the low conductivity of their heat. When not overdone their dehydrating effect is soothing, but often the value may be overestimated. The optimal technic for hot and cold baths was described (Holmes; Pennington), so also was the value of hot-water fomentations (Philips) and of foam baths ("useful for fat arthritics" according to Hill), an improved type of Hubbard tank for underwater therapy (Currence), an inexpensive homemade whirlpool bath suitable for arms and legs (Boynton). Brine baths may stimulate circulation through some osmotic effect on skin; they are useful in chronic, but not in subacute, atrophic arthritis (Neligan). The deep or reclining immersion bath in conjunction with undercurrent douching or manipulative exercises is most useful in quiescent atrophic arthritis (Copeman and Thomson), but should not be used in any case of infective or true rheumatoid arthritis with the "slightest sign" of clinical activity: their skins and joints are too sensitive to it, and they may react poorly even to the mildest hydrotherapy. The advantages of spa therapy were stressed.

Fever therapy was considered of some value (Snow) and by Ferderber who noted "improvement" in 11 of 28 cases classified as chronic atrophic, acute infectious, chronic infectious, and rheumatoid arthritis. This therapy seemed of little value to others (Thompson, Wyatt and Hicks). In Paul's 28 cases, results of treatment were "excellent" in 11 per cent, good in 43 per cent, insignificant in the rest. Others disapproved of the usual sessions of fever, but approved of the use of "mild sessions" (101 F. for one hour).

Low Back Pain. H. H. Boucher.

Vancouver M. A. **16**:252 (June) 1940.

Lack of postural tone is a common cause of chronic low backache. The patient stands with the head and shoulders forward and down, the abdomen relaxed and the pelvis rotated forward. If the patient is thin the knees are usually slightly flexed, while if stout they are extended, possibly as a bracing effect. A degree of flat-foot is often present. In the presence of such relaxed musculature the ligaments alone offer support and static strain follows. Correction of this condition is accomplished by braces, corsets, or remedial exercises, possibly a combination of support and exercise. The success of the treatment depends upon the cooperation of the patient as he cannot be successfully "braced" into correct posture. A light brace of the Goldthwait type may be used in certain cases and in others a well-fitting full length corset is more applicable. Unless there is a contraindication, remedial exercises should be taken. The latter are by no means the usual exercises as taught in the gymnasiums. A special group has been developed by Goldthwait, based upon the use of correct abdominal breathing. It would be correct to say that few of us breathe properly and if we do, it is more by accident than by design. Goldthwait has established certain principles which he described in his book "Body Mechanics." One will probably not agree with some of his ideas as to the relation of posture to disease, but one will find that his principles of treatment are sound. They are being used in the physiotherapy department of the Vancouver General Hospital for both out-patients and private patients and have produced good results.

Passive Transfer of Light Sensitivity. J. Lamar Callaway.

Arch. Dermat. & Syph. **41**:889 (May) 1940.

Although sensitivity to light has long been recognized and studied extensively, there has not been any report in this country of the successful passive transfer of such sensitivity. During the past three years Callaway has had occasion to study rather carefully a patient who was particularly sensitive to light and has been able, using a modified Prausnitz-Kustner technic, to transfer his sensitivity passively to 3 different normal persons. A brief report of the case and of the details of the passive transfer experiment is presented. The causative agent of this patient's sensitivity has not been determined. There is an increase of coproporphyrin I, the source of which is obscure, and its relation to the light sensitization has not been demonstrated. No method of desensitization has so far been satisfactory. What-

ever the sensitizing substance, it has in this case been relatively transferred four times to 3 subjects, including the author.

Artificial Fever and Chemotherapy for Dementia Paralytica. A. E. Bennett; J. C. Nielsen, and A. H. Hastings.

Nebraska State M. J. **25**:40 (Jan.) 1940.

In comparing the clinical remission rate of dementia paralytica following the various types of treatment, Bennett and his colleagues find that 12 per cent of patients obtained clinical remissions after chemotherapy (tryparsamide) alone, 42 per cent from malarial fever followed by chemotherapy and 53 per cent from combined artificial fever and chemotherapy. Of twenty patients with early dementia paralytica, a full remission was obtained in 65 per cent with partial improvement in 30 per cent. Complete serologic reversal of the spinal fluid was obtained in 40 per cent with partial reversal in 30 per cent after continued artificial fever and chemotherapy. Of ten patients with dementia paralytica with tabes a full remission was obtained in 50 per cent and a partial one in 30 per cent. The spinal fluid was reversed completely in 40 per cent and partially reversed in 10 per cent. Of twenty-eight patients with advanced dementia paralytica committed to a state hospital, 54 per cent obtained a full clinical remission and 28 per cent a partial remission. A complete serologic reversal of the spinal fluid occurred in 28 per cent and a partial reversal in 50 per cent. Of twelve patients failing to obtain a full remission from malarial inoculation, 33⅓ per cent obtained a full remission and an additional 25 per cent was improved following fever and chemotherapy. The spinal fluid was reversed to negative in 33 per cent and improved in 41 per cent. The results from artificial fever, fifty hours above 105 F., combined with mapharsen in the entire group of seventy cases of all stages of dementia paralytica, were full remissions of 53 per cent with an additional 28 per cent improved. A complete serologic reversal of the spinal fluid occurred in 34 per cent, with partial reversal in an additional 37 per cent. — [J. A. M. A. **114**:925 (March 9) 1940.]

Use of Intravenous Sodium Chloride in Pyrotherapy. Eric E. Rosenberg, and Norman N. Epstein.

Am. J. M. Sc. **199**:650 (May) 1940.

During the past 5 years more than 500 patients were treated with artificial fever by the blanket method. Results have been satisfactory and with few serious reactions. Despite oral administration of various concentrations of salt solutions, nausea and vomiting were observed in 60 per cent of patients. The literature mentions few remedies effective in preventing this sequella. Accordingly the authors studied many methods of salt administration and advise the intravenous use of hypertonic saline solution (5 per cent) immediately preceding artificial fever. This was found to be of considerable value in reducing the incidence, frequency and severity of nausea and vomiting. It was also effective in reducing the incidence and severity of reactions of intolerance to heat and post-therapeutic debility. Administration of salt by this method was found simple and rapid. It was accompanied by very few untoward reactions and little or no discomfort. The intravenous administration of hypertonic saline solution preceding pyrotherapy was a marked tendency to increase fluid intake and to diminish fluid output. As evidenced by changes in weight, there is a tendency toward retention of fluid. This retention seems to alleviate or prevent certain undesirable reactions that are seen in artificial fever therapy. The therapeutic effect is probably explained chiefly by the osmotic action of the sodium chloride.

Fever Therapy for Intestinal Obstruction Due to Pelvic Disease. B. A. Smith.

Surgery **7**:166 (Jan.) 1940.

Smith reports two cases of mechanical obstruction of the small intestine, secondary to gonorrheal adnexitis, treated by hyperthermy. The hyperpyrexia must be carefully supervised. The treatment is delayed, if possible, until a positive or stationary weight balance is maintained. Dehydration, chloride depletion and alkalosis are readily thrown out of balance during artificial fever in the presence of intestinal obstruction and must be checked frequently. A "wet" chamber is used to produce and maintain fever, as fluid and chloride losses by perspiration are less and hyperventilation is less marked than when a "dry" chamber is used. From reported cases the impression is gained that mechanical intestinal obstruction in gonorrheal adnexitis in most cases is caused by agglutination of intestinal loops to the inflammatory mass; it is probable that this is true in conditions resistant to the usual conservative regimen. — [J. A. M. A. **114**:1118 (March 23) 1940.]

Effect of Temperature on Mechanical Response and Viscosity and Oxygen Consumption of Unstriated Muscle. Manjeshwar Sadashiva Rao, and Inderjit Singh.

J. Physiol. **98**:12 (March) 1940.

The optimum temperature for tonic contraction in frog muscle is 20 C. and in Mytilus muscle 14-15 C.; that for the alternating current contraction in frog muscle is 25-30 C. and in Mytilus muscle 20 C. The optimum temperature varies with the composition of the saline solution. Two factors determine the excitability with change of temperature; one of these is adaptation.

Decrease in temperature and tonic contractions diminish the rate of rise of tension during a. c. stimulation, the subsequent rate of relaxation and the rate of change of length on isotonic stretch and release. Normal tone requires oxygen. Most tonic contractions produce an increase in the oxygen uptake. Stimulation with a. c. 12 V/10 sec./min. for 12 min. increases the oxygen uptake by 100 per cent. Oxygen uptake is increased during inhibition produced by sodium and ammonium ions. Isotonic sodium chloride

causes frog muscle to lose weight; calcium antagonizes this action.

An Improved Method of Applying Short Wave Diathermy. F. K. Nagelschmidt.

Brit. J. Phys. Med. 3:82 (May) 1940.

Some peculiarities of the short wave condenser field are described. Disadvantages of the ordinary condenser field electrodes are explained. The behaviour of dielectrics in the short wave field is examined. For this purpose the author has evolved a new type of short wave electrodes, which practically prevents loss by radiation or leakage; enables strict localization without interference with prominent parts of the body and produces superficial or deep effects.

Application can be made to the skin or through clothes, or at a small distance. From the point of economy, small apparatus can be efficiently used, and a lower output can be obtained with large apparatus. The author describes some types of electrodes, and measures energy by a simple hot-wire ammeter.

Tuberculous Tracheobronchitis. Robert S. Jenks.

Rev. Tuberc. 41:692 (June) 1940.

Treatment of tuberculous tracheobronchitis has not advanced greatly since the complication has been recognized and authorities differ as to the effectiveness and safety of various types of therapy. No articles have appeared accurately evaluating any therapeutic method. In the way of general treatment, high vitamin C diet is thought to be beneficial. Subcutaneous injections of tuberculin have proved ineffective. Antispasmodics, atropine, adrenalin, elimination of allergens, autogenous sputum vaccines, ammonium chloride and cough syrups have afforded only temporary relief. Roentgen treatment has been productive of good results in some cases, though a few were thought to have been made worse. There is indication that generalized ultraviolet radiation may be of value. There is no treatment which has been described for nonulcerative and nonstenotic lesions except direct ultraviolet (mercury vapor) radiation as applied by Kernan, who uses this therapy for ulcerations and "tuberculous tumors" as well. The radiation is applied to the affected area through the bronchoscope for a period of twenty minutes at intervals of two to three weeks. No results of this therapy have been published, but Kernan believes the lesions heal more rapidly and in a larger percentage of cases, and that there is less subsequent fibrous contraction. When considerable edema and congestion accompany the hyperplastic types, temporary or sometimes protracted relief may be obtained by the application of a solution of equal parts of 10 per cent cocaine and adrenalin 1:1000. Barnwell, Littig and Clup reported spontaneous regression in the majority of their cases with hyperplastic lesions.

Cyclodiathermy Puncture in Cases of Glaucoma. Alfred Vogt.

Brit. J. Ophth. 24:288 (June) 1940.

Vogt and his assistant have studied the reactions of diathermy punctures of the ciliary body for glaucoma and now feel it timely to describe this operation as well as to recommend it as a valuable antiglaucoma-operation. Hitherto this operation has been confined to the cyclodiathermypuncture in those severe cases where iridectomy and other methods with subconjunctival filtration had failed. Every ophthalmologist has at times found himself at a loss to combat certain malignant forms of glaucoma. Especially in these cases can this operation be of great use.

Above all it is almost exclusively employed in cases of glaucoma haemorrhagicum, further in cases of aphakic eyes or after contusions where glaucoma is caused by the vitreous obstructing the angle of the anterior chamber, as well as in the similar cases of traumatic or spontaneous luxation of the lens. In the remaining cases it is used as a secondary operation after iridectomy or an operation aiming at subconjunctival filtration, sclerotomy or when cyclodialysis had been previously performed without success.